



# Delaware's Environmental Legacy

Shaping Tomorrow's Environment Today

**CZIC COLLECTION**

## REPORT TO THE GOVERNOR AND THE PEOPLE OF DELAWARE

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Delaware's  
Environmental  
Legacy

Shaping Tomorrow's Environment Today

January 26, 1988

The Honorable Michael N. Castle  
Governor of Delaware  
Legislative Hall  
Dover, DE 19901

Dear Governor Castle:

I am pleased to submit to you the final report of the Delaware Environmental Legacy program. The report contains 122 recommendations to help ensure that future generations of Delawareans will continue to enjoy a clean, healthy environment.

Delaware is fortunate to enjoy a rich natural setting and an abundance of natural resources. Overall, we have done a good job of managing these resources through a variety of environmental protection laws, regulations and programs. However, we are faced with a number of serious challenges that could undermine our ability to preserve or improve our environment. Projected population increases, continued economic growth, a rising sea level and pollution generated by nearby states are indicators of potential future environmental stress.

Our recommendations directly respond to a wide range of specific issues, but also recognize the interdependence of our natural resources so that actions taken to correct one problem will not have detrimental effects on other components of our environment. Further, we believe that we will face difficult decisions in the years ahead about our lifestyles and how they impact the quality of our environment. To this end, the formation of an implementation team is recommended to carry on the legacy program and develop the specific means for carrying out our recommendations. Over 150 people, representing all sectors of the community directly participated and have benefited from an increased understanding and commitment to improving our environment. Our hope is that we have achieved much more. We hope that we have begun a movement to elevate environmental issues on the public agenda in Delaware. We hope that each one of us will renew our commitment to protect our natural resources, and that our effort will be viewed as a model for other states to follow.

Finally, I would like to personally thank the program's Steering Committee who made tremendous personal commitments to the development of this report, and to you Governor, for having the vision to create this program and provide us with the opportunity to participate.

Sincerely,

A. Douglas Rothwell  
D.E.L. Chairman

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## PREFACE

In the closing years of the 20th century, man is becoming very uneasy about the condition of his environment. The capacity of the environment to absorb the increasing volume of wastes he generates, is in danger of being overloaded and if that occurs on a continuing basis, the environment can be permanently damaged. Poorly managed development and the other burdens placed on the environment due to a growing population and economy, can significantly add to that damage. We have an obligation to bestow a decent environmental legacy to future generations, to prevent exhaustion of our non-renewable resources and to maintain the health of our ecologic systems. If we are to prevent long term environmental catastrophe we must develop an environmental ethic that will help us understand and accept the idea that all citizens have a personal stake in assuring the quality of their environment. Shaping tomorrow's environment requires a strong commitment by government and private citizens for action today. This report documents Delaware's intention to deliberately and responsibly make that commitment.

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## INTRODUCTION

Governor Castle announced the creation of the Delaware Environmental Legacy Program in April, 1986 in a speech to the Delaware Chapter of the American Chemical Society. The governor called for "a long ranged plan, one that will assure that Delaware's environmental legacy will be undiminished as we begin the 21st Century." The program was officially established by Executive Order Number 34 which outlined the following objectives:

- a. Gather and evaluate the general public's opinion on Delaware's emerging long-term environmental issues.
- b. Create broad state and local understanding of the interrelationships between quality of life, economic development and the management and protection of natural resources.
- c. Develop an agenda that outlines an action-oriented set of recommendations to resolve issues and problems.
- d. Prepare and submit to the governor a report that establishes a framework to carry out recommendations.

The executive order also created a steering committee to guide program development and prepare the final report. The governor appointed A. Douglas Rothwell as chairman and 27 individuals from the public and private sector as members.

From the outset, the need for broad public participation was recognized. The process used by the environmental legacy program was one of the most extensive public-private initiatives ever conducted in Delaware. The following recaps the chronology of key program activities.

- . The program began with a symposium in Lewes, Delaware on September 15, 1986 to review the state's past environmental record and begin identification of the most pressing environmental issues facing the state now and those expected to face the state in the future. Over 35 of the state's environmental, civic, government and business leaders participated.
- . A follow-up symposium was held on November 17, 1986 to develop the process for addressing issues, formulating recommendations and securing public input. Nearly 70 community leaders and state officials attended this event. At the meeting, five working committees were established: Air Resources, Water Resources, Waste Management, Ecological and Living Resources, and Land Use Management.
- . Several organizations and associations were requested to submit written comments on what they perceived as the critical long-term environmental issues facing the state. Thirty-four responded with 95 pages of commentary.

- . Three hundred households throughout the state were sampled by the University of Delaware to assess public attitudes on key environmental issues.
- . Three additional, ad hoc Committees were formed to address: Adult Environmental Awareness, K-12 Environmental Education, and Beach Management.
- . One hundred twenty-two (122) individuals representing a diverse range of geographic, community, occupational and philosophical interests were appointed by Mr. Rothwell to serve on the working and ad hoc committees. Two members from each working committee were appointed as committee co-chairs and served on the program's steering committee as well.
- . Ninety-two meetings were held by the working and ad hoc committees involving approximately 300 hours of discussion.
- . Each working committee held at least one workshop to seek public input. Over 150 members of the public participated in these workshops or attended regular working or ad hoc committee meetings.
- . Three public workshops were held in early January, 1988 to review the draft report. The workshop held in Kent County also served as the final symposium for the program involving all members of the steering, working and ad hoc committees, and the general public.
- . The final report was submitted to the governor in late January 1988, nearly two years since the inception of the program.

# SUMMARY OF KEY FINDINGS AND RECOMMENDATIONS

## INTRODUCTION

In the 19th and 20th centuries, economic priorities and issues of development have taken precedence in the formation of public policy. The result has been the tendency to undervalue and at times, ignore the environmental impacts of those development decisions. What has become increasingly accepted and pursued is the belief that a more prudent path is to remedy this imbalance. The Delaware Environmental Legacy Program is recognition of the continuing need to intervene on behalf of the environment.

What we still have to learn about the effects of the materials and wastes we produce and loose into the environment far exceeds what we know. And yet, what we know strongly suggests that loss of habitat, species, open space, land, and reductions in the quality of water and air endangers our well-being. To minimize the further contamination of air, water and land, and to restore and maintain, ecosystem vitality and diversity are environmental management objectives of the state. The Legacy Program is intended to help ensure the achievement of those objectives.

Fragmented efforts are no longer adequate to deal with the complexity, the increasing toxicities, and the sheer pervasiveness of present environmental problems. Delaware's Environmental Legacy Program recommends a more comprehensive approach to coping with these threats to our environment.

What has also become very clear during the legacy process is the existing deficiencies in information needed to do an adequate job of managing our environment. Accordingly, recommendations are made to improve our knowledge of Delaware's natural environment and the impact that man and nature's actions can have on it.

In some cases this knowledge can be improved through better coordination between governmental agencies at all levels and by asking the private sector for help. This report recommends a number of steps to improve coordination, particularly between state and local government. Inasmuch as certain pollutants have their sources out-of-state the report makes recommendations to promote initiatives on a regional level and to get the U.S. Congress involved. These regional issues especially involve ozone, acid rain, and the improvement of water quality in the Delaware Estuary.

The report not only includes recommendations intended to deal with today's and tomorrow's environmental issues, but it recognizes the importance of nurturing an environmental ethic which will make us more aware of the relationships of all human activities and the natural environment. Particular attention has been placed upon establishing a formal environmental education program in the schools.

## SUMMARY OF KEY FINDINGS

Managing our environment in the future will be more difficult than in the past because:

- \* Past trends and future projections of population, economic activities and other factors, when considered along with the size, geographic setting and natural makeup of our state, indicate that stresses on our environment will increase in the future.
- \* Environmental problems are more complex today than in the past and will become increasingly more complex in the future, taxing the states capability to deal with them.
- \* Management of our environment in the future will be increasingly more expensive. The need to tighten up on existing measures and to institute new ways to protect our air and water, to clean up our wastes, protect and restore our ecological habitats, stabilize our eroding beaches and protect other important environmental resources, will be very costly.
- \* A quality future environment will require greater coordination and cooperation among state, local, regional and federal governments and with the private sector. Particularly important will be the role of local government in controlling environmentally sensitive land use.
- \* Individuals will be more important than ever in providing for a quality future environment. For the most part, environmental laws have led industry to control pollutants to acceptable levels but little has been done regarding household hazardous wastes, voluntary water use restrictions during droughts and indoor air pollution. In addition, citizens may have to live with certain restrictions and will have to understand and be willing to be a direct participant in managing the environment.

## **PART I**

# **SETTING THE STAGE FOR TOMORROW'S ENVIRONMENTAL CHALLENGES**



## **SUMMARY OF KEY RECOMMENDATIONS**

### **1. Ways to sustain our present air quality**

- \* Delaware needs to seek a regional solution to the state's ozone problem which is aggravated by emissions from upwind states.
- \* The state must develop an air toxics control strategy to include substantial participation and assistance from the private scientific community.
- \* The state should develop a statewide indoor air pollution control program.
- \* Delaware must continue to maintain vigilance over the potential effects of acid precipitation.

### **2. Ways to protect the state's water resources**

- \* Groundwater aquifer recharge areas should be protected through land use restrictions and other controls by state and local governments.
- \* Require water saving plumbing devices in new buildings and in those being rehabilitated.
- \* Improve programs to monitor and control toxic chemicals.
- \* Implement a program to clean Delaware's lakes and ponds and keep them clean.
- \* Provide increased resources and other means to protect groundwater.
- \* Establish stormwater management programs on a statewide basis with state and local government coordinating activities.
- \* Help to assure availability of water through regionalization and, where feasible, the interconnection of facilities.
- \* Adopt a water systems financing policy to assist local governments in rehabilitating and expanding water systems.

### **3. Ways to help manage and curtail the increasing wastes that will be generated by the state's expected population and economic growth in the next generation**

- \* Construct a second waste reclamation project to serve Kent and Sussex Counties.
- \* Develop a program to reduce the generation of hazardous and non hazardous wastes.

- \* Increase citizen awareness of household hazardous wastes and their proper disposal and support a program to collect and dispose of such wastes.
- \* Adopt a policy of "recycling" land fills rather than developing new ones.
- \* Establish a fund for the cleanup of Delaware's hazardous waste sites and other hazardous material spills.
- \* Oppose use of the Delaware River and Bay as a transportation corridor for ocean bound hazardous wastes incineration vessels.

#### 4. Ways to help sustain and/or restore key ecologic habitats and other important environmental resources

- \* Protect freshwater wetlands through legislation and other means.
- \* Implement sufficient pollution controls so that waters in the Delaware River can restore and sustain populations of anadromous fish and other species that have seriously declined over the years.
- \* Conduct a comprehensive study of the Delaware Estuary and Inland Bays.
- \* Provide adequate funds, legislation and other means, including closer cooperation by local governments, to protect Delaware's critical natural and cultural areas.
- \* Consider all activities carried out within a watershed in a "holistic" manner, where emphasis is placed on the functional relationship between each activity.
- \* Develop a comprehensive land acquisition program to ensure adequate open space is preserved for the protection of important natural resources and for outdoor recreation.
- \* Develop a strategic management plan to assure continued protection of Delaware's beaches.
- \* Increase environmental protection and conservation measures on agricultural lands principally by expanding the role of local conservation districts and by encouraging ways to improve the farmer's financial well-being.

#### 5. Ways to make better environmentally sensitive land use decisions, particularly the placement of roads, sewers and other major "infrastructure" that can pose serious environmental consequences.

- \* Require all local government land use regulations and infrastructure placement decisions be consistent with comprehensive development plans and allowing plans to be amended only where the benefits of amending the plan are for

the good of the community at large; and by requiring that state environmental protection policies and standards be incorporated into local plans.

- \* Improve coordination between state and local governments regarding land use matters through legislation and other means.
- \* Encourage development and growth within existing communities as opposed to scattered growth and supporting that concept through taxing policies, impact fees and other means of directing growth.
- \* Encourage and fund public transportation where practicable.

**6. Ways to help inculcate an environmental ethic in our citizenry**

- \* Integrate environmental education into the public schools from kindergarten to grade 12 in a more formal manner.
- \* Improve and expand adult education opportunities.
- \* Create a Delaware environmental institute.

# PART I

## SETTING THE STAGE FOR TOMORROW'S ENVIRONMENTAL CHALLENGES

### INTRODUCTION

The environmental legacy that will be left to Delawareans of the 21st century will in many ways be a continuation of a legacy already enjoyed by present day citizens through prudent attention to our environment during the last few decades. The favorable quality of life that most Delawareans enjoy today has come about because a healthy environment and a strong economy have reinforced each other. Despite that relatively happy partnership a number of environmental problems face the state and have to be dealt with.

Delaware poses special environmental management considerations due to its natural setting. Many of those considerations have been successfully addressed by far sighted environmental initiatives, including a number of important laws, regulations, policies and plans.

The economy of the state, while serving to provide the necessary economic base upon which a healthy environment can be sustained, nevertheless, poses threats to environmental quality if certain activities are not carefully managed.

Stresses on Delaware's environment will increase in the future, principally because of expected population and economic growth. Although it is impossible to accurately predict the effects that these and other factors will have on the environment, it is important to consider past trends as indicators of possible future consequences.

### DELAWARE'S NATURAL SETTING AND THE ENVIRONMENT

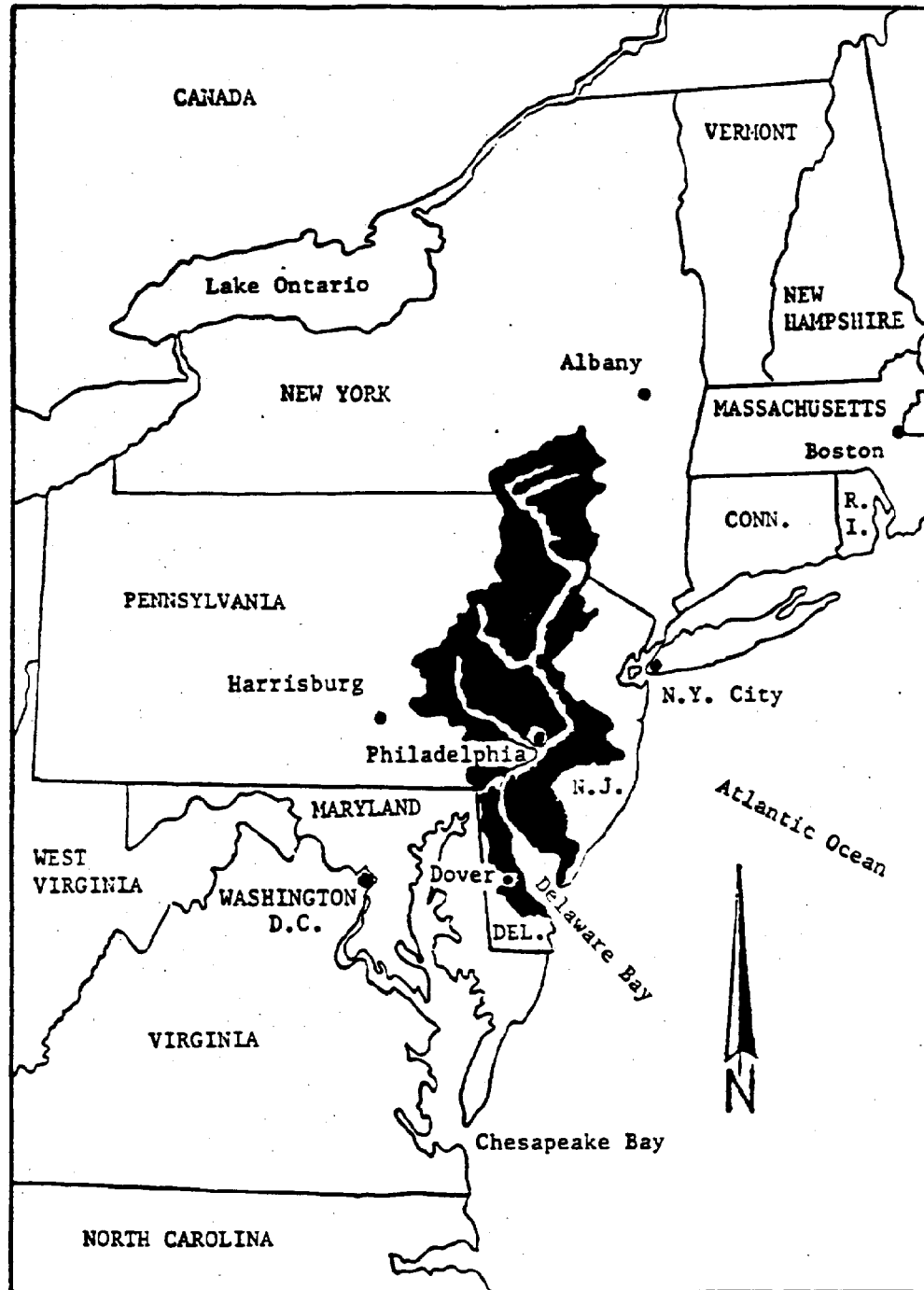
Delaware's natural setting - its geographical location, topography, geology and other natural characteristics - has been and will continue to be a factor that has important implications on the state's environmental quality.

Delaware, the second smallest state, is located on the eastern seaboard of the United States. It is bordered on the north by Pennsylvania; on the east by New Jersey and the Atlantic Ocean; and on the south and west by Maryland. The total area of the state is about 2,045 square miles stretching roughly 96 miles in length and from 9 to 35 miles in width. Figure 1 shows Delaware's regional setting.

Delaware lies entirely within the Atlantic Coastal Plain except for its northern tip, which is part of the Piedmont Plateau. The state's highest elevation is 442 feet near Centerville, New Castle County. The rolling hills and pastures of the north give way to marshy regions in the south and with sandy beaches along the coast. Delaware's mean elevation of 60 feet is the lowest in the United States.

Delaware's population of just about 630,000 is the third smallest in the country. The population density of Delaware is about 314 people per square mile. More than two thirds of all Delawareans live in metropolitan areas. The

Figure 1  
Delaware's Regional Setting



Source: Delaware River and Bay Authority

Delaware River Basin - ■

largest cities of the state are Wilmington, Newark, and Dover, the capital. From colonial times Delaware has been divided into three counties: New Castle in the north, Kent in the center, and Sussex in the south.

Delaware's geographical position is reflected in its mixture of northern and southern flora and fauna. Since Delaware is situated on the Atlantic flyway, it provides summer nesting and winter feeding grounds for great numbers of migratory geese, ducks, and shorebirds. There are several wildlife sanctuaries including the Bombay Hook and the Prime Hook national wildlife refuges, both on the shores of Delaware Bay.

Characteristics of the mid-Atlantic coast, Delaware's climate is temperate and humid. Prevailing winds blow from the northwest in winter and southwest in summer.

Being a small coastal state a continuous interaction of land and water influences virtually everything. Indeed, no part of Delaware is more than eight miles from tidewater. The Delaware River and Bay is the water gateway to a great industrial and commercial complex of the Delaware Valley. Hundreds of ships travel up and down its course each year. At the deepwater anchorage off Big Stone Beach, huge tankers lighten their holds of crude oil before safely proceeding to upriver ports. Proposals involving the construction of superports, coal transfer facilities and the use of the river and bay as a traffic lane for ocean bound hazardous waste incineration vessels, have periodically surfaced over the years. While nothing has come of those proposals, principally because of Delaware's strong Coastal Zone Act, concern for these potentially environmentally harmful activities lingers.

The state's Atlantic ocean beaches and inland bays provide superb outdoor recreation opportunities for millions of visitors throughout the mid-Atlantic region. The inland bays are also part of a system of shallow water estuaries which are the nursery and rearing grounds for most species of finfish important to commercial and sport fishermen along the east coast of the United States. Overcrowding of the beach and bay communities continues to be particularly threatening to the area's environmental resources.

The tidal wetlands in Delaware, encompassing about 120,000 acres, provide breeding areas and food for birds, mammals and shellfish, and are part of the aesthetic quality of the shore region. Loss of wetlands to development continues to be an issue.

Delaware possesses an extensive network of streams and a patchwork of freshwater ponds that support a wide variety of aquatic ecosystems. While some streams in northern New Castle County are fast moving, cool waters, most are sluggish and slow-moving. Shallow streams which receive discharged sewage wastes or other pollutants can have their waste assimilation capacities overburdened, particularly in periods of drought. In turn, living creatures in the stream can be severely impacted. Additionally, poor flushing capacities of the state's shallow mill ponds combined with pollutant runoff from the land can contribute to degradation of water quality, rendering the pond unsuitable for fishing, swimming or other uses.

Except for northern New Castle County, the remainder of the state lies in a coastal plain where elevations are typically below 50 feet. Here, groundwater storage capacity is a major asset but water supplies lie close to the surface

and are vulnerable to contamination from septic systems, leaching dumps, leaking underground fuel tanks, agricultural fertilizers and pesticides, chemical spills and other sources.

Prevailing winds bring in air contaminants generated in upwind states to the west of Delaware. This situation compounds the problem of controlling ozone, air toxics and acid precipitation and could have an important impact on the state's economic development and transportation policies.

The history of Delaware is preserved in the thousands of historic dwellings and significant archaeological findings located throughout the length and breadth of the state. The loss or potential loss of these treasures remains a problem to be dealt with.

The many environmental issues that Delaware's natural setting contributes to will continue to face the state in the future. This report will touch on many of them.

## DELAWARE'S RECORD OF ENVIRONMENTAL ACHIEVEMENT

As Delaware renews its commitment to deal with tomorrow's environmental problems, it is important to know that the job has been underway for sometime. One of the state's earliest environmental concerns was the availability of potable water. The demands of accelerated growth in the early twentieth century pointed out the problems associated with obtaining sufficient amounts of water for human use. No longer was it enough to merely locate additional sources. Available supplies had to be maintained. What was clear even in the early part of the century was that providing an adequate supply of clean water to Delawareans involved protecting water from contamination.

The state code of 1915 stipulated that the board of health had the specific power and duty to:

provide for the sanitary protection of all water supplies which are furnished to and used by the public; and provide for the proper selection, storage, and disposal of sewage, household wastes, and garbage by public authorities and individuals'."

The code went beyond merely recognizing that the handling of wastes was an issue of public health and that the state should take an active role in the protection of drinking water and the regulation of contaminants. The law specifically set forth the protection of natural resources.

'No person shall, cast, put, place, discharge in, or permit or suffer to be cast, put, placed, discharged in, or to escape into any running stream of water within the limits of the State, from which stream the inhabitants of any borough, town, or city within this state are supplied wholly or in part with water for and as drink or beverage, any dyestuffs, drugs, chemicals or other substances or matter of any kind whatsoever, whereby, and by means whereof, the water so supplied as and for a drink or beverage as made and becomes noxious to the health or disagreeable to the senses of smell or taste'.

Within the same code additional statutes empowered the game and fish commission to protect against contamination and pollution of state waters. Provisions of the code expanded list of prohibited substances to include "coal or gas tar, sawdust, tan bark, berries, lime, refuse from gas houses, oil tanks

or vessels, or any other deleterious, destructive or poisonous substances...". Although the code regulated the industrial wastes that entered domestic sewers, the manner of their disposal into streams was not prescribed except for poultry and slaughterhouse wastes.

In the years following the enactment of these early environmental laws the 'dilution is the solution to pollution' approach more or less gave way to the 'an ounce of prevention is worth a pound of cure' concept.

Between 1939 and 1945 the "Interstate Commission on the Delaware River Basin" established reciprocal agreements between New York, New Jersey, Pennsylvania and Delaware "to conserve and safeguard water resources in the River Basin".

Problems with multiple discharges and non-point sources complicated the administration of existing statutes, leading to additional legislation in 1949 to deal with industrial wastes.

By the end of the fifties, the extent of the relationships between the various aspects of environmental management was increasingly recognized. The Intrastate Water Resources Survey of 1959 reflecting this awareness clearly stated that the problem of a sufficient water supply could not be solved without simultaneously dealing with industrial wastes disposal, land use control, etc.

Over time, the cumulative effects of human activities adversely effected more and more of the state's environment. The realities of these consequences led to a broader understanding that the general well-being of the public is closely tied to the quality of the environment. Consequently, Delaware has increased its efforts to provide for an effective legal basis for action. Especially in the past two decades, a variety of important environmental legislation has been passed. During this period the Delaware Environmental Protection Act, which underpin's our air, water and waste regulatory programs was passed. Before most states and the federal government began to worry about coastal zone management, Delaware enacted its coastal zone act, a statute that has recently received national attention and one that most Delawareans look at with near reverence. Wetlands and underwater lands acts soon followed. Also during this period the Delaware Solid Waste Authority was formed and developed the Delaware Reclamation Project and state-of-the-art landfills in each county. For over 35 years, the Delaware Geologic Survey, largely through a series of almost 200 publications has defined the natural framework relevant to many environmental concerns and has anticipated many of our presently recognized problem areas.

Delaware has worked in partnership with the federal government in a number of key environmental areas where it has shown to be a leader among states. For example, Delaware's Coastal Management Program was among the first approved by the federal government. Delaware was among the first states in the nation and the first in the mid-Atlantic region to receive hands-on responsibility from the EPA to regulate industrial and municipal wastewater discharges. Delaware was also the first state in the mid-Atlantic region to receive authority from the EPA to administer construction funds to local governments for wastewater facilities. Delaware was the first state in the entire nation to be entrusted by EPA to carry out the regulation of hazardous wastes. In 1985, Delaware enacted a law to help prevent and control leaking underground tanks which was selected among 18 other state laws by the National Conference of State Legislatures to serve as a model underground tank law.



Numerous other environmental laws have been enacted in the past few years and a number of important environmental management initiatives taken in a seemingly never ending effort to keep up with emerging environmental issues.

## THE ECONOMY AND THE ENVIRONMENT

Contrary to popular belief a healthy economy and a healthy environment are not only compatible but are interdependent. For example, tourism, Delaware's third most important industry is vital to the overall economy of the state. If the waters of the ocean and bays become polluted to the point where fishing, swimming and other water sports would be severely curtailed, the economic loss to the state would be severe. Moreover, the economic impact from ecologic damages would significantly add to that loss.

Economic growth means the capability to develop energy efficient housing, industrial pollution control equipment, the ability to acquire and preserve open space including the preservation of agricultural lands and the wherewithal to do other things to assure stewardship of the environment. Thus, environmental values are also economic values and it makes sense from an economic standpoint to protect and conserve our environmental resources.

However, many components of Delaware's economy, the chemical, petrochemical, and other industries, power utilities, food processing plants, agriculture, tourism and resort development, although helping to provide that needed economic base have nevertheless impacted or at least have the potential to impact the state's environmental resources.

Burgeoning coastal area development and its impact on a finite resource is of significant concern, particularly since this type of development (which is driven by the quality of the environment and the quality of its recreational resources) has thrived despite a national building recession.

Large uses of water for industrial cooling and processing and the discharge of contaminants into the atmosphere can have serious consequences if not treated and controlled properly.

Agricultural practices also have the potential to pollute surface and groundwaters if proper pesticide and fertilizer application, manure storage and other environmentally safe practices are not followed. Overland flow from irrigation and rainfall can wash chemicals and nutrients into surface and groundwaters and in some areas of the state cause soil to erode.

While, overall, the state has been able to maintain the quality of its environmental resources, that quality continues to be sensitive to changes in the economy. As more industry comes into the state, the potential for additional pollution increases, depending on the nature of the industry. While some firms create little or no direct environmental problems, a new smoke stack industry (or expansion of an existing one) can add to the amount of air pollution and, in the case of some pollutants such as ozone, potentially effect the ability of industry to expand or locate here.

With expectations of an increased population growth of over ten percent by the year 2000 and the economic growth that will accompany it, the stresses on Delaware's environmental resources will increase. Consequently, it will be vital that economic development and environmental resources management become

better coordinated. The next section of the report considers a number of factors that are expected to produce continuing stresses on the state's environment.

## EXPECTED STRESSES ON DELAWARE'S ENVIRONMENT

Gradually, but very persistently, Delaware has experienced steady growth in population and economy. Improved access to many of the state's natural resources such as the Delaware Bay and shore areas have accompanied that growth, bringing thousands of visitors and summer residents to the state. Other activities including farming, building construction and general patterns of land use have also changed and expanded. While these factors by themselves may be socially beneficial, together they place ever increasing burdens on the capacity of Delaware's natural environment to absorb, dilute, disperse or obscure the residues of human activity. If carrying capacities are continually exceeded, the quality of the state's natural resources and the enjoyment derived from them can significantly decline.

A number of factors such as trends in population growth, economic activities, and travel and tourism are useful in gauging the stresses likely to impact Delaware's natural resources as the state continues to grow. Many of these indicators demonstrate that in recent years pressure on Delaware's natural resources has increased and can be expected to be even greater in the future.

### Population

Probably the most significant and direct indicator of future strain on Delaware's environmental resources is the expected growth in population. Between 1970 and 1986 Delaware's resident population has grown at a steady rate of one and one-half to two percent annually, and is currently above 630,000. Delaware's resident population is expected to increase at a rate of just under one percent annually with an anticipated increase of 13% between 1990 and 2010. Figure 2 shows projected population growth for each of Delaware's three counties. Another perspective from which to assess the magnitude of population changes occurring is to follow the upward trends in population density as illustrated in Figures 3, 4 and 5.

The projected steady rate of population growth and increased density suggest that pressures on the state's natural resources will increase and will inevitably impact all aspects of the environment. A growing population will need more space for recreation and better access to the state's waters. A burgeoning population will require more housing services and infrastructure, such as sewers, roads, and energy; will require more potable water; consume more land for residential and commercial purposes and will generate wastes in greater quantities. Growth will put people and buildings closer to sensitive natural areas increasing the potential for their degradation. While it is unlikely that these environmental tensions can be completely avoided, the negative impacts of growth can be minimized through improved coordination, cooperation and careful management.

### Economy

A number of economic development factors are likely to impact the environment. The types of businesses and industries recruited, where they choose to locate, their infrastructure and labor requirements and the land scape changes which result will impact Delaware's natural environment to varying degrees.

Figure 2  
 POPULATION PROJECTIONS BY COUNTY  
 1970-2010 (FIGURES ROUNDED)  
 DELAWARE

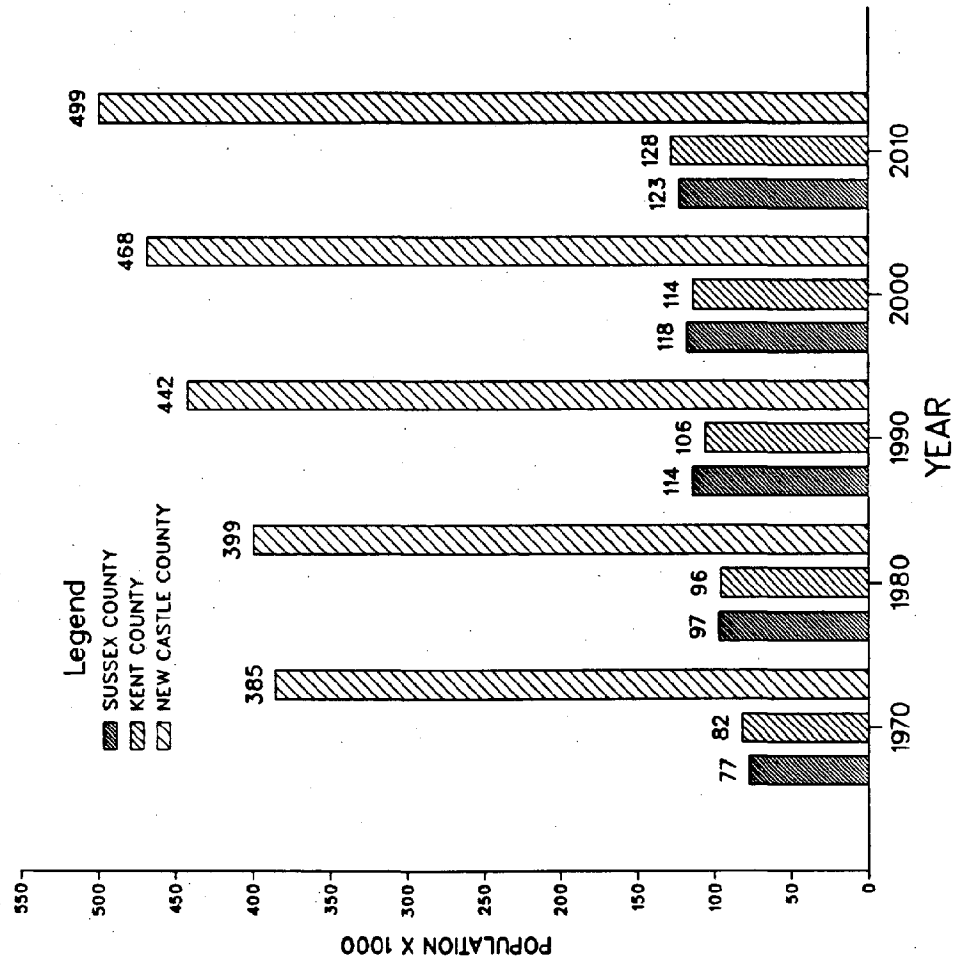


Figure 3

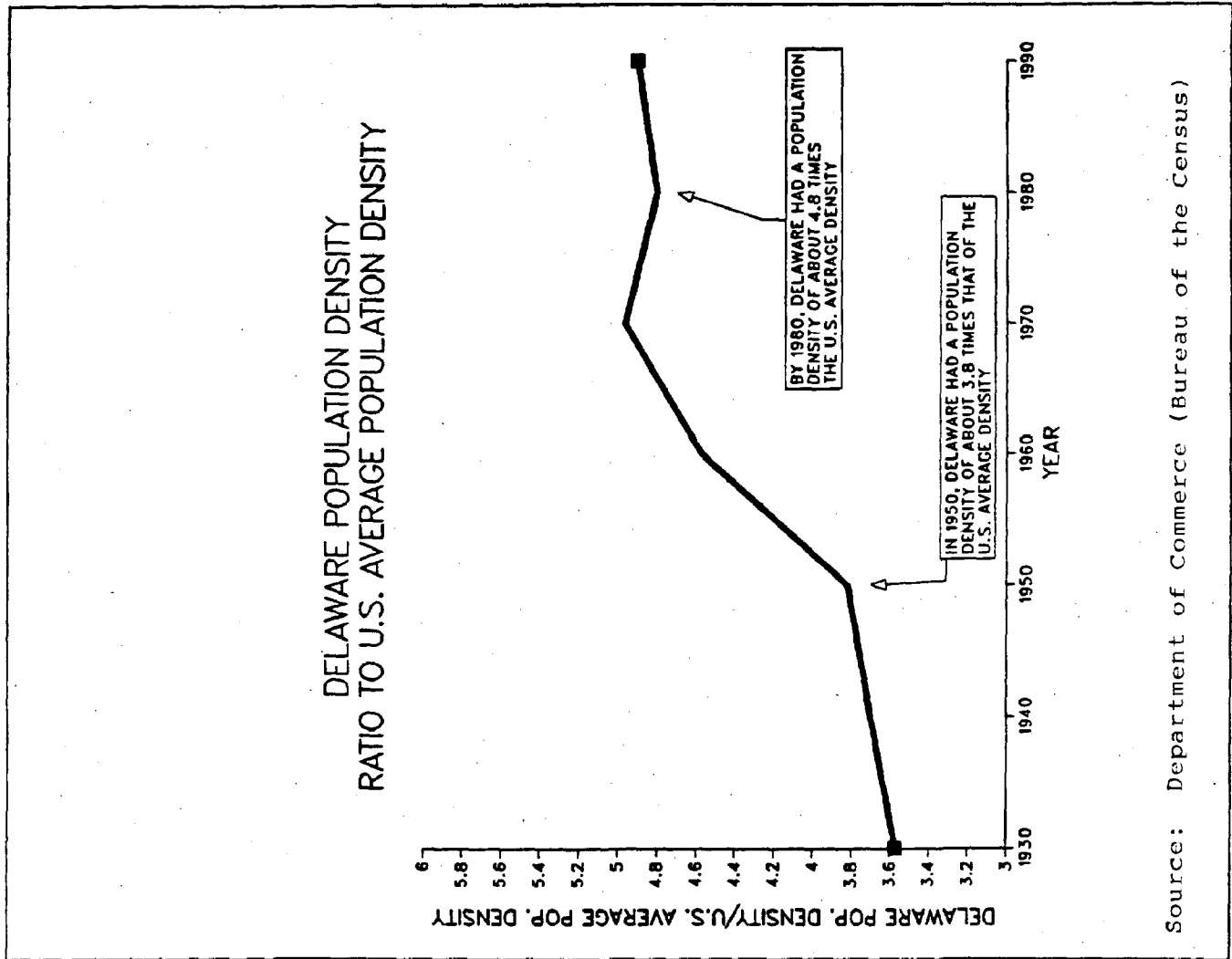


Figure 4

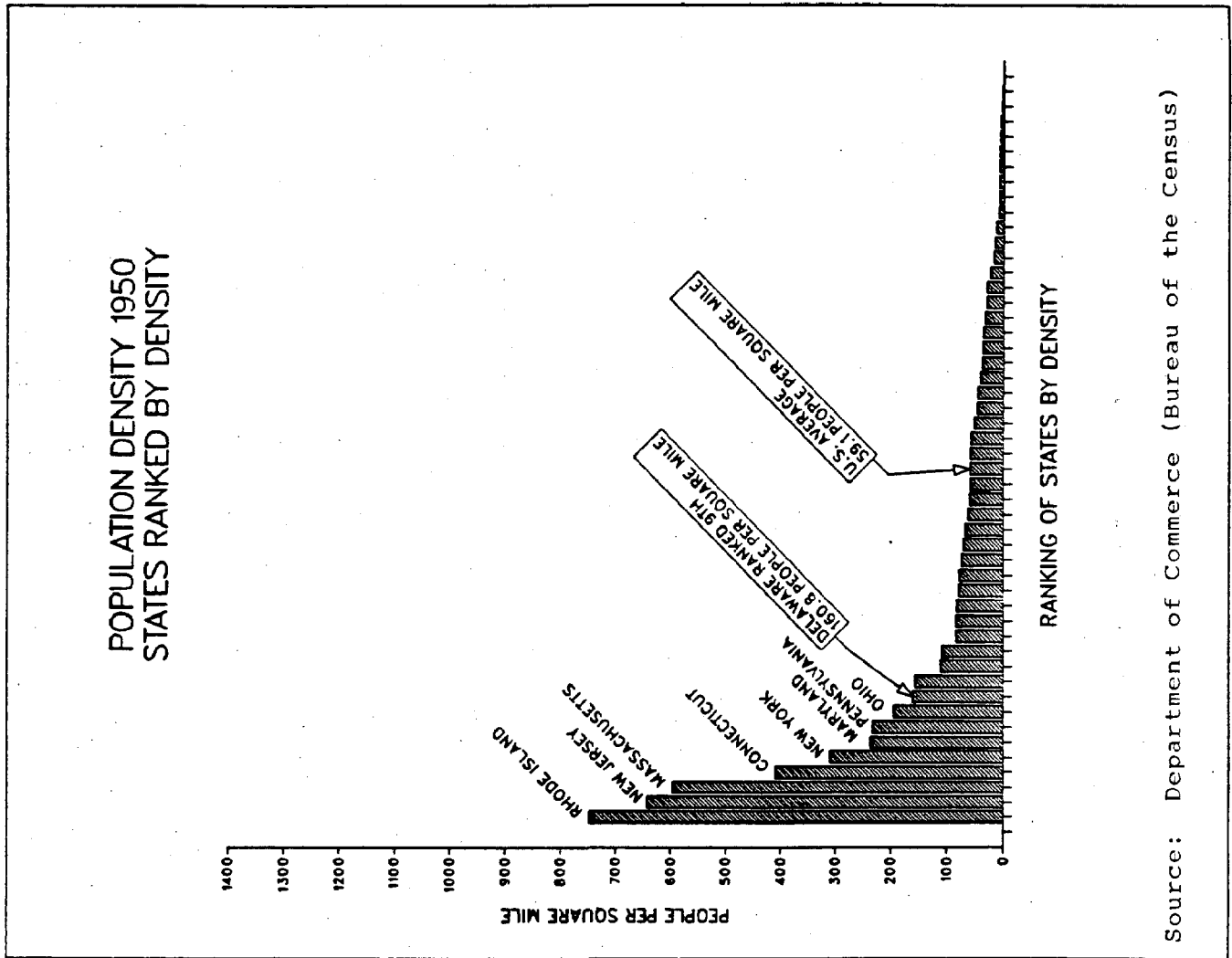
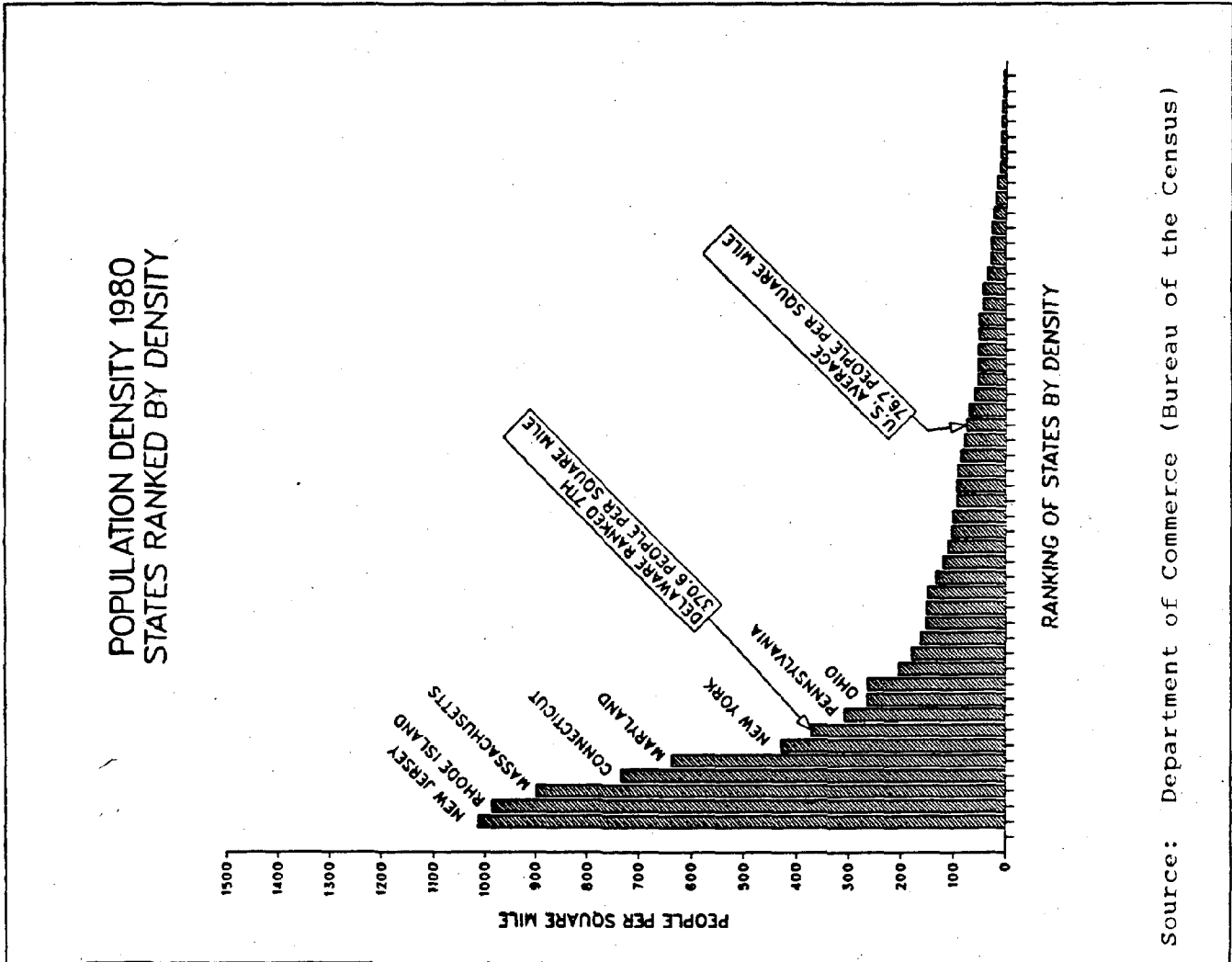


Figure 5



One economic activity which is particularly significant is the travel and tourism industry. Tourism, the third largest industry in Delaware, is likely to create additional stresses on the environment because it largely promotes the state's coastal areas, the location of our most critical ecological and recreational natural resources. As Figure 6 indicates, travel expenditures have more than doubled since 1977, with spending increasing from \$318 million in 1977 to more than \$650 million in 1985. This trend is expected to continue.

Other economic development factors may contribute to future strain on Delaware's environment. Whether, for example, the state seeks to promote and attract heavy manufacturing and industrial operations or financial and service oriented industries will largely determine the degree to which the environment will be impacted.

In the last few decades, Delaware has been fairly effective at sustaining a mix of large chemical and manufacturing industries and service businesses without significant impacting the state's environment. Recent trends in employment (non-agricultural) demonstrate that Delaware has gradually shifted from a heavy reliance on manufacturing to a balance of manufacturing with retail trade and service oriented businesses (see Figures 7 through 10). Despite this apparent shift, economic development and environmental policy makers will have to be sensitive to the impacts of economic growth on the environment.

## Transportation and Housing

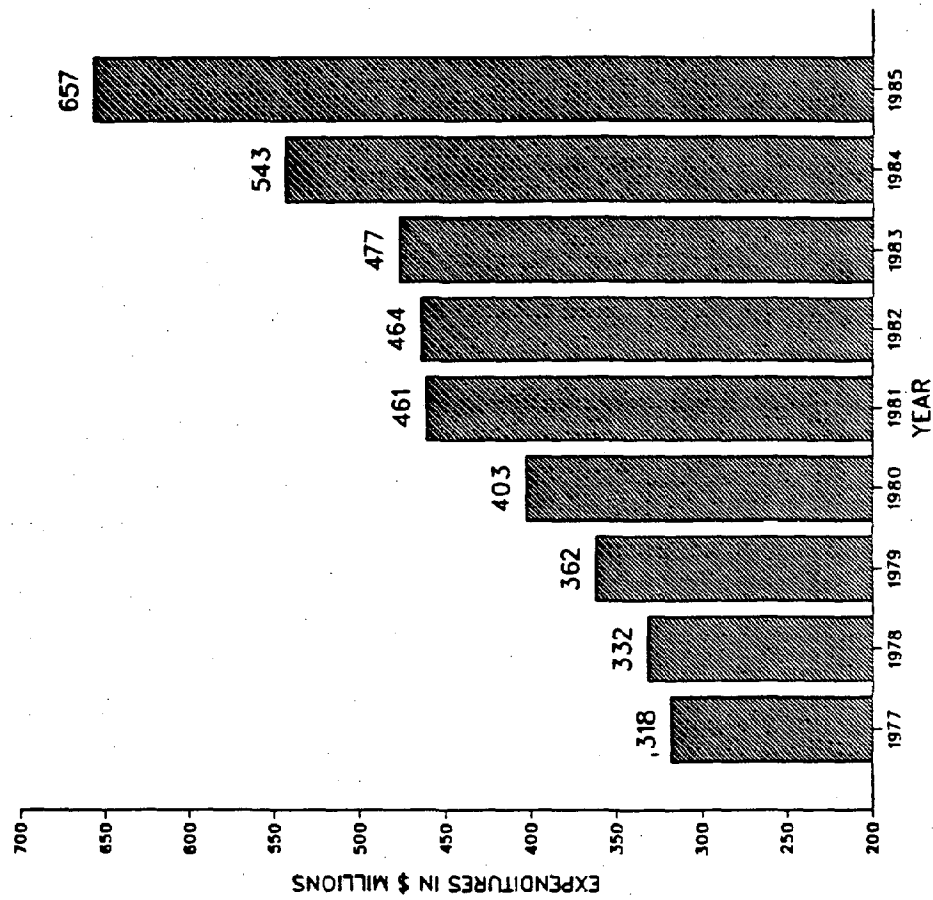
Two factors related to population growth and its effect on the environment are transportation -- how Delaware's population moves about in the environment -- and housing -- how and where that population chooses to locate. Transportation and housing have the potential to place a significant strain on Delaware's environment since they greatly influence land use patterns throughout the state.

Transportation decisions can place substantial stress on the environment because the most widely used means of transportation, the automobile, requires a land intensive infrastructure -- roads and highways. Trends in motor vehicle registrations suggest that automobile use in Delaware is increasing. As Figure 11 indicates, the number of licensed drivers and registered vehicles have steadily increased over time. This increase, however, does not take into account the steady stream of out-of-state vehicles which pass over Delaware highways, principally in the summer months. These trends suggest that motor vehicle use in Delaware will continue to increase, presenting an even greater strain on the environment, particularly in terms of the need to bulldoze more and larger roads out of the landscape to carry more motor vehicles which in turn will add more pollutants to Delaware's airshed.

The amount of land we consume for housing, and the proximity and density of that housing to sensitive environmental resources can directly impact the quality of those resources. Since 1970, the volume of housing production has largely fluctuated with trends in the national and local economies. Production of housing units dropped off significantly in 1974 and again in 1981 in a depressed economy. Figure 12 indicates the volume of housing production, particularly single family units (which typically require more land than multi-family structures), has steadily increased from 2,989 units in 1980 to 7,726 units in 1986, with much of this growth concentrated in Kent and New Castle Counties. As Delaware's economy continues to grow, the volume of housing

Figure 6

TOTAL TRAVEL EXPENDITURES  
1977-1985  
DELAWARE



Source: Delaware Development Office



Figure 7

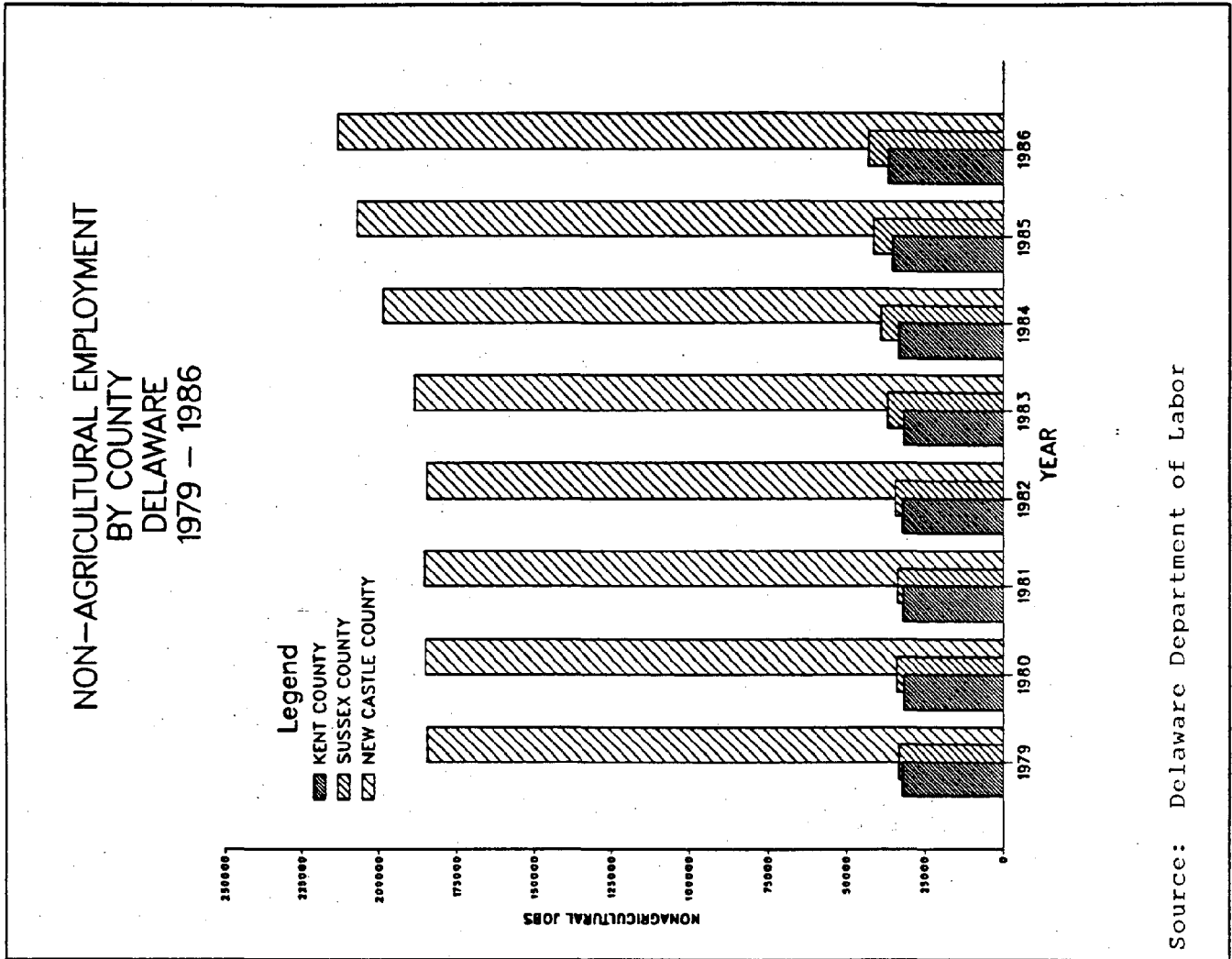
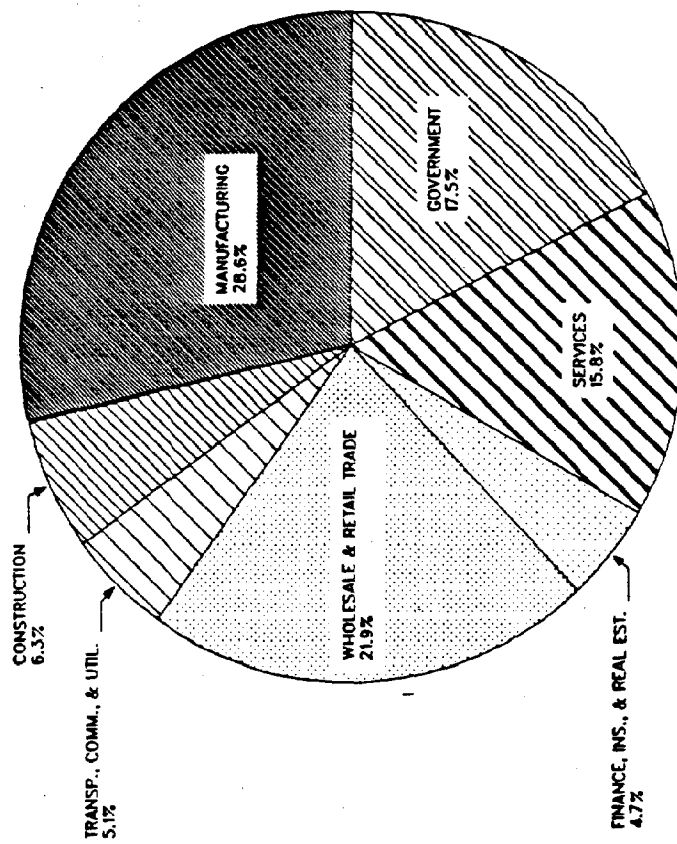


Figure 8

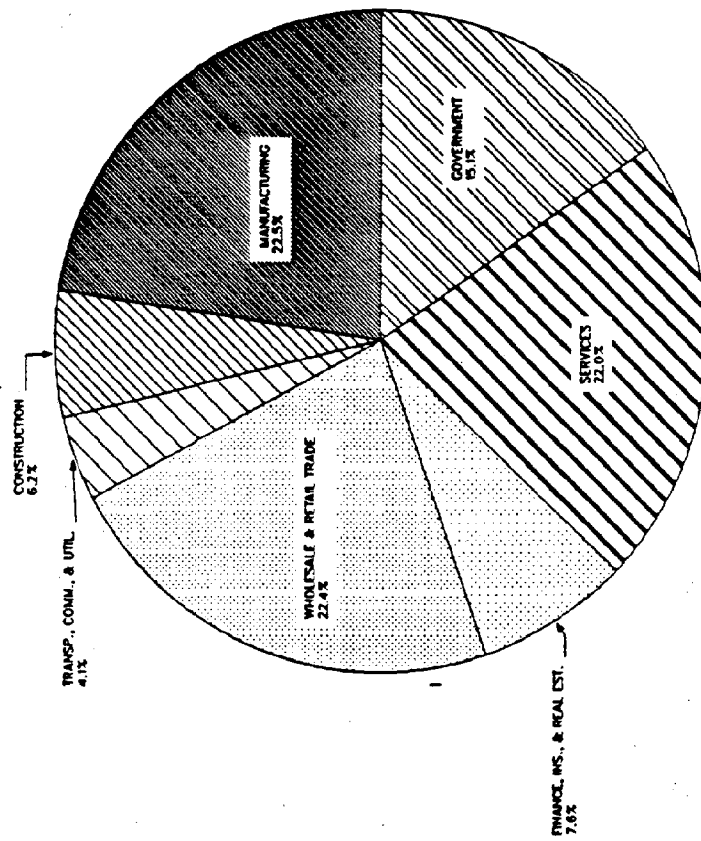
DELAWARE NON-AGRICULTURAL EMPLOYMENT SUMMARY  
BY SECTOR  
1975 IN PERCENTAGE OF TOTAL



Source: Delaware Department of Labor

Figure 9

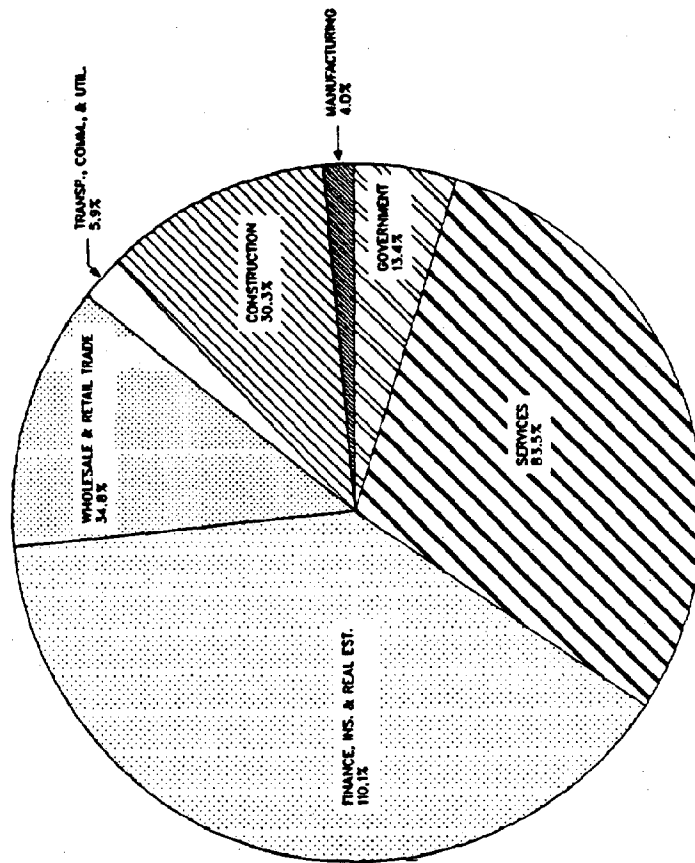
DELAWARE NON-AGRICULTURAL EMPLOYMENT SUMMARY  
BY SECTOR  
1986 IN PERCENTAGE OF TOTAL



Source: Delaware Department of Labor

Figure 10

DELAWARE NON-AGRICULTURAL EMPLOYMENT SUMMARY  
BY SECTOR  
PERCENTAGE CHANGE 1975-1986



Source: Delaware Department of Labor

Figure 11

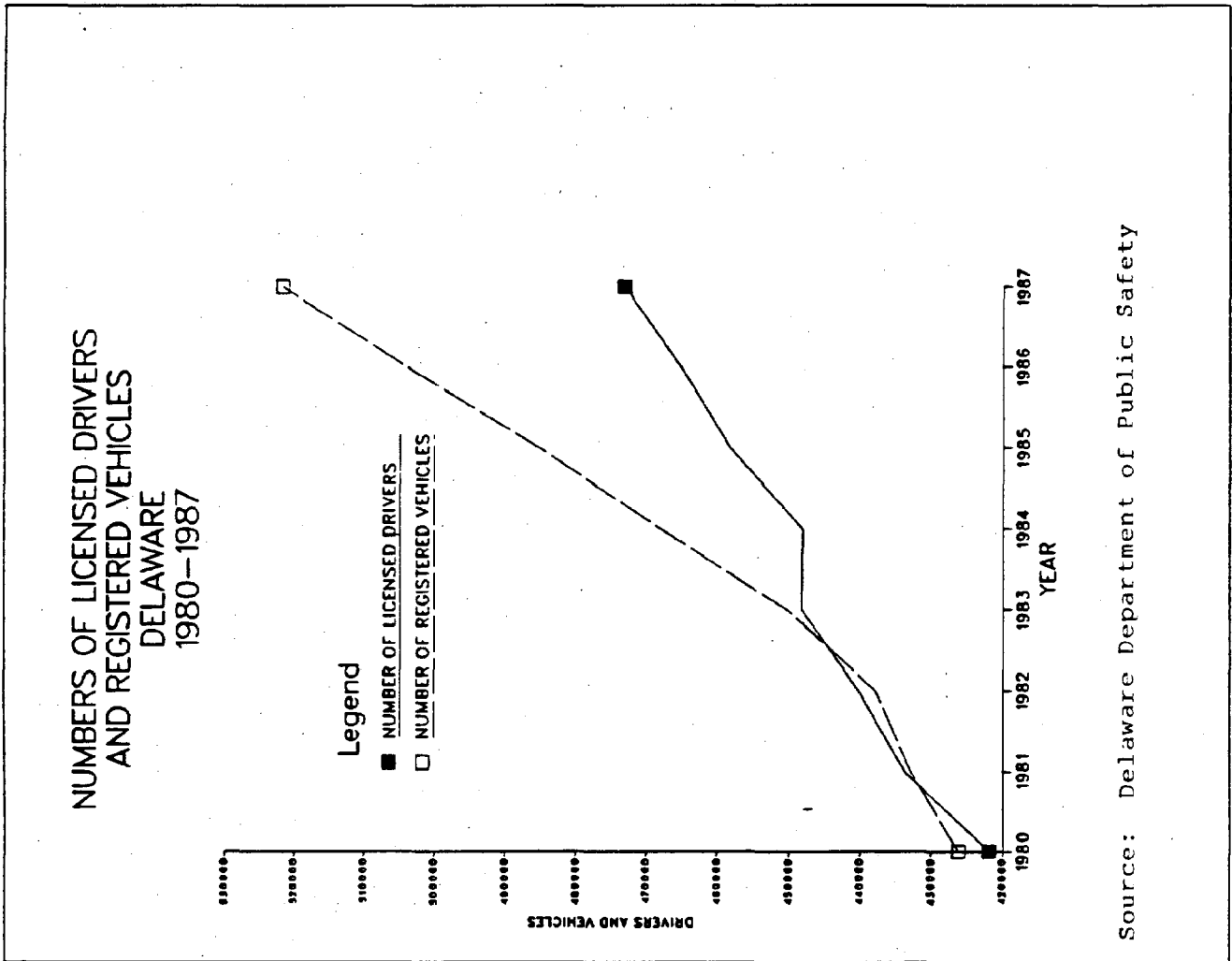
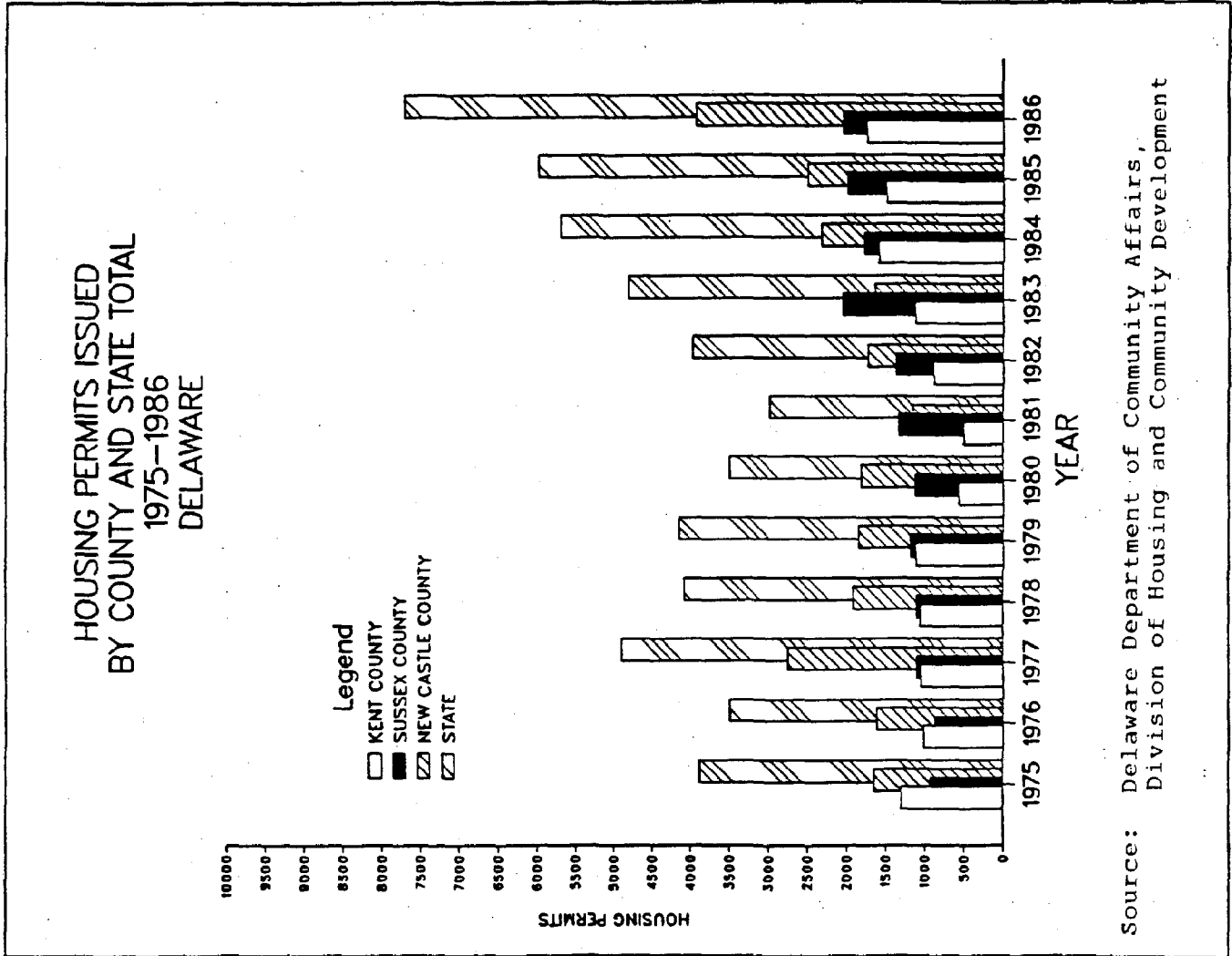


Figure 12



produced is expected to increase. This happenstance, however, will further stress environmental resources due to increased infrastructure requirements, consumption of more land, and the loss of open space and wildlife habitat.

## Other Indicators of Environmental Stress

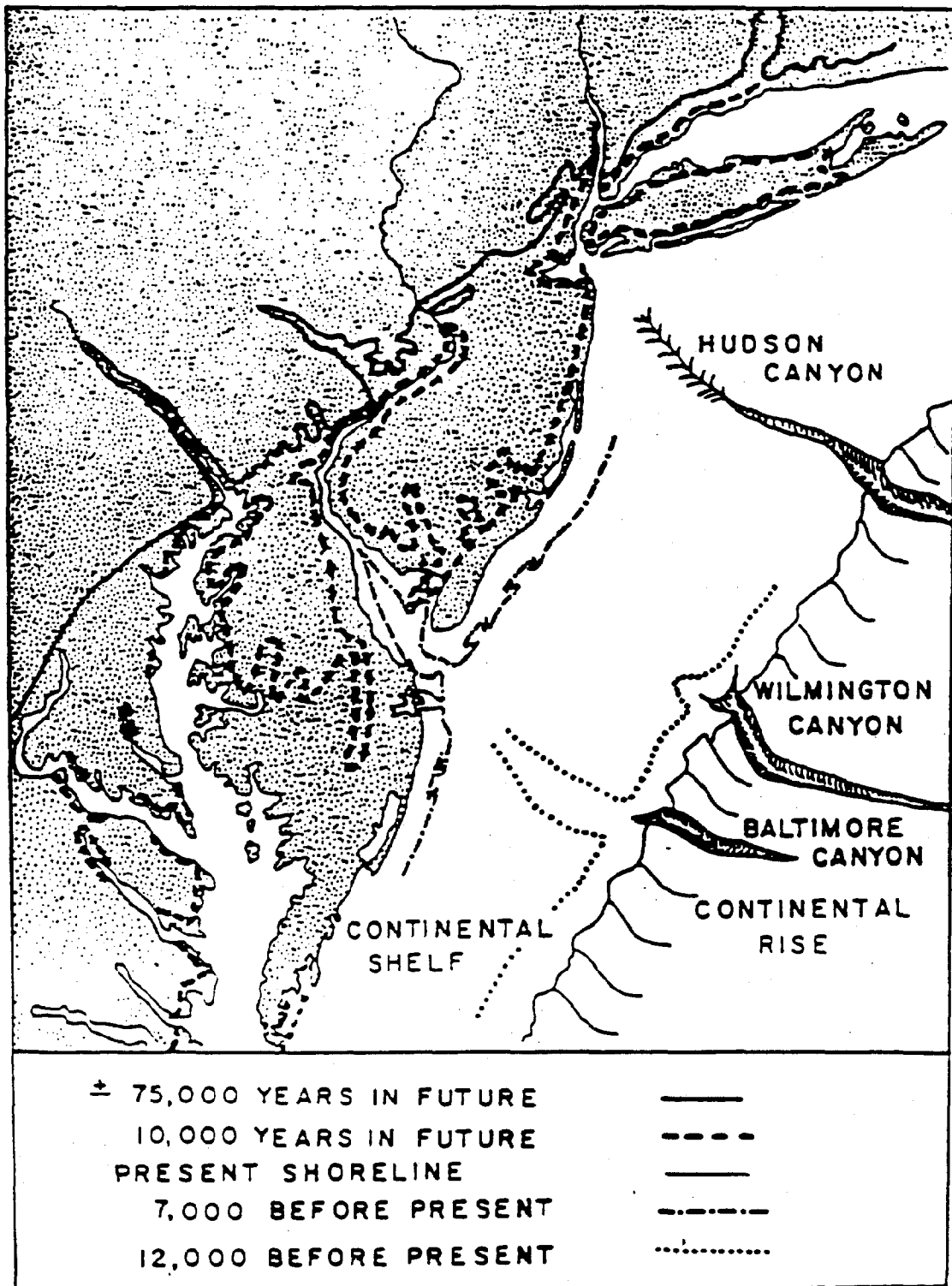
A number of other trends or indicators can be indicative of what pressures may likely come to bear on Delaware's environment in the future. Some are the result of naturally occurring processes which cannot be changed by man such as the natural movement of the shoreline and the gradual rise in sea level. Other indicators may be man-induced, resulting from pollution or overtaking of resources, like the decline in anadromous fish landings in the Delaware estuary.

One long-term phenomena which will continue to have serious environmental implications is the migration of Delaware's shoreline. Sea level has not remained constant through time but has risen and fallen relative to land surface. Several thousand years ago, the Delaware shoreline was located considerably east of where it is today. Several thousand years from now it will lie considerably west of where it is now. Figure 13 shows this relationship. For the past 2,000 years sea level has been rising at a rate of about one-half foot per century. More recent evidence suggests, however, that the rate has accelerated to one foot per century and will continue to increase in the future. This situation will have significant implications for Delaware's coastal regions where by the year 2000 the shoreline can be expected to have moved 70-90 feet landward from its present position. Such a condition will clearly threaten existing beach front properties all along the coast. As the shoreline continues to migrate landward, the state will be forced to make some critical decisions regarding the construction of properties on the beachfront and general land use patterns along the coastline. Impacts on wetlands, fin and shell fisheries and saltwater intrusion into aquifers will also become greater.

Another indicator which suggests continue strain on Delaware's environmental resources is related to the number of commercial and recreational fish landings. Figure 14 illustrates that since the early 1900's anadromous fish landings (which is a key indicator of the environmental condition of fish habitat) have dramatically declined from more than five million pounds to less than 600,000 pounds in 1983. The reasons for this decline are many and include pollution of the lower Delaware River, (which has been responsible for the elimination of important spawning areas in the Philadelphia to Wilmington part of the river) and overfishing of declining stocks. Although recent improvements in Delaware River water quality and a reduction in habitat loss has helped stabilize fish populations in the estuary, the low dissolved oxygen conditions are still severe enough to represent a continuing stress, particularly in light of future pollution induced by a growing population. Compounding the issue is the need for an interstate solution.

Delaware's shellfish populations have experienced declines similar to those observed with fin fish populations. Particularly hard hit have been the oyster and hard clams. In 1947 over four million pounds of edible oyster meat was harvested. By 1984 that figure decreased to less than 200,000 pounds. The hard clam landings also dramatically declined from 10.2 million clams in 1965 to 616,000 clams in 1985. Shellfish declines can be attributed to pollution, overfishing and the introduction of diseases such as MSX.

Figure 13

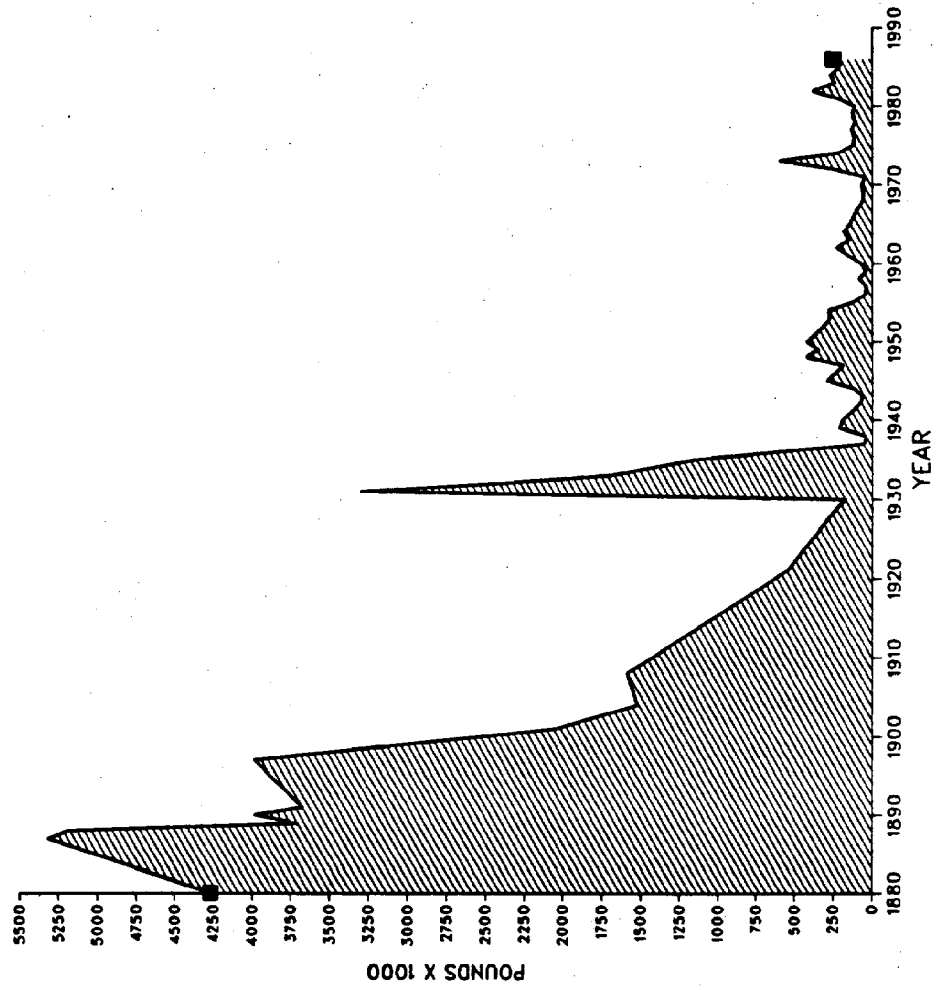


Paleogeography of the Delaware-New Jersey continental shelf area: past, present, and future.

Source: Delaware Division of Soil & Water Conservation



Figure 14  
ANADROMOUS FISH LANDINGS  
1880 - 1986  
DELAWARE



Source: Delaware Division of Fish & Wildlife

Other factors which may continue to place a stress on Delaware's environmental resources include the loss of freshwater wetlands and the variety of open space needed to support wildlife habitat. It is estimated that since colonial days as much as one-half of the state's original freshwater wetlands have been lost. Between 1955 and 1980, about 20% of remaining freshwater wetlands were lost (as much as 1,500 acres per year) due primarily to drainage and development. Continued loss of freshwater wetlands over time will seriously affect the ecological processes that these wetlands provide.

Delaware has experienced similar trends in the loss of open space including forest and agricultural lands which provide habitat for a diversity of plant and animal life. From 1974 to 1984 nearly 26,000 acres of farmland were lost to more intensive land uses and urbanization. With Delaware's growing population and the increasing demand for more intensive land uses, these resources remain vulnerable.

## Summary

The trends described above suggest that Delaware's environment is likely to undergo continuing and intensified pressures induced by population and economic growth, and the need for increases in transportation infrastructure and housing. Historic trends in the loss of important estuarine resources will be difficult to reverse and some factors such as sea level rise will be impossible to really effectively deal with. Subsequent pages of this report address in detail a number of these concerns.

## **PART II**

# **NEW IMPLICATIONS FOR ENVIRONMENTAL MANAGEMENT**

## **PART II**

### **NEW IMPLICATIONS FOR ENVIRONMENTAL MANAGEMENT**

The environmental quality that Delawareans enjoy today will be difficult to sustain in the future. While significant achievements have been made over the last twenty years, the complexity, costs and scope of environmental issues will be much more difficult to solve.

We could often taste, smell or see environmental perils in the past. Our rivers were dirty, the air was clouded with industrial smoke and some of our wildlife was disappearing. But today, our environmental threats come from toxic chemicals in the air, water and soils, stresses placed on the environment by our growing economy, and even global natural phenomena such as rising sea level.

### **INCREASED TECHNOLOGICAL COMPLEXITY**

We know less about how our environment works and the threats posed to it than what we know. While we may be able to measure environmental conditions, we find it difficult to determine the risks posed by these conditions on man or nature. Our efforts to clean-up hazardous waste sites are a good example of this. Costly investigations are undertaken to determine the condition of dump sites before clean-up may begin. Yet, the value of such extensive studies is undermined by our limited understanding of what these conditions might ultimately pose to public health and the environment. Meanwhile, the public rightfully demands prompt action to "do something."

Risk is a fact of life that we live with. We will have to face the issue of deciding how much risk is acceptable more often when addressing future environmental issues. We can strengthen our ability to cope with the uncertainties of risk through greater and more informed public debate of the associated trade-offs. However, to get to the heart of these largely new and unknown risks requires extensive sampling, monitoring, epidemiological and other studies all of which take a great deal of time and money. Consequently, it will be vitally important for environmental managers to have the technological capability to deal with risk and the other, ever more complex issues that are continually emerging. It will be that much more important in the future when the costs of environmental management will be increasingly higher.

### **GREATER COSTS FOR ENVIRONMENTAL IMPROVEMENTS**

While we spend more money to protect and manage our natural resources today than at any time in the past, managing our environment in the future will cost even more.

For example, while the costs of removing initial pollutant risks are modest, they increase disproportionately as continued improvements are sought. When 30 percent of oxygen demanding pollutants (BOD) have been removed from a plant's waste discharge, the cost of removing an additional pound of pollutant is only about a dime. But once 90 percent of the BOD is removed, each additional pound costs about 75 cents to remove. When 95 percent of the BOD has been controlled, the cost per additional pound reaches nearly one dollar.

The principal source of these costs will be reflected in higher taxes and higher product prices that all citizens will pay. Consequently, we cannot determine how clean we want our environment without also confronting decisions concerning our economic quality of life. Figure 15 illustrates how the marginal costs of keeping the economy and environment in equilibrium will be very high in the future.

## THE NEED FOR IMPROVED COORDINATION

Tomorrow's environmental challenges cannot be met by one state, group or individual acting alone. It will take the coordinated efforts of many people and organizations to solve our most critical environmental problems. Environmental issues can no longer be neatly categorized. For example, ozone or acid rain cannot be addressed in a vacuum by Delaware if upwind states are not involved, nor can, one person's indiscriminate disposal of hazardous wastes be treated as a singular act without cumulative effects.

Coordination is needed at all levels to meet tomorrow's environmental challenges. We must:

- . Establish regional relationships with our neighbor states to solve mutual problems;
- . Encourage partnerships between the public and private sectors;
- . Improve working relationships between state and local governments, especially on land use planning matters; and
- . Achieve a meaningful dialogue between environmental managers and the public to identify and propose effective and safe solutions to problems.

## THE ROLE OF THE INDIVIDUAL

Perhaps the single most important implication for environmental management in the future is recognizing the important role each individual will have to play.

Each individual helps shape environmental issues by deciding where they build their home, how they dispose of their wastes, what goods and services they purchase and how they communicate their concerns for the environment. How we live determines the quality of our environment.

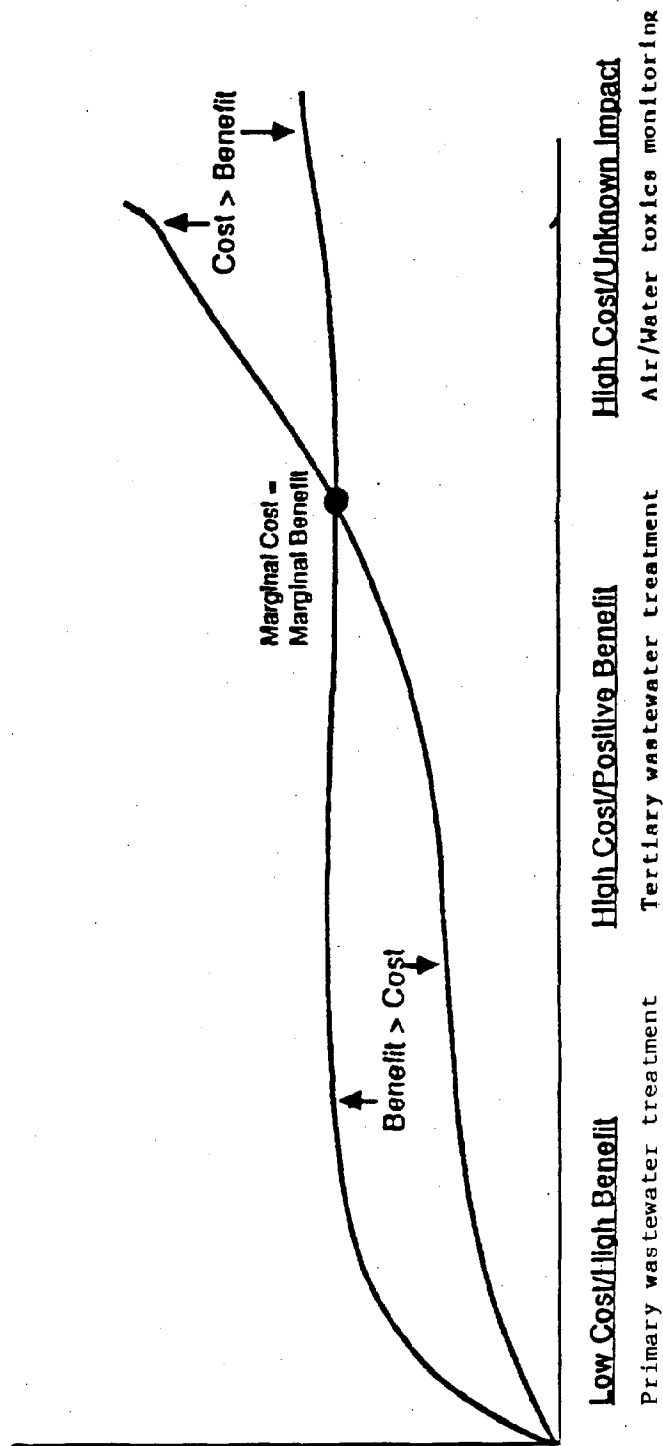
Becoming aware of how our actions affect nature is not a replacement for government action. But when individuals take stewardship for the environment, the private sector, government and civic organizations are more likely to also respond. Throughout this report there are numerous examples of the increasing importance of the individual in taking care of our environment.

**PART III**

**TOMORROWS ENVIRONMENTAL  
CHALLENGES**

Figure 15

## Marginal Cost & Benefit Overview



Source: Department of Natural Resources and Environmental Control

## INTRODUCTION

Tomorrows environmental challenges will be difficult to meet. As shown earlier, the nature of environmental management will be different from that of the past principally because of increasing technological complexity, rising marginal costs, the need to more closely coordinate and integrate actions and the role that all citizens will have to play.

Many of tomorrow's environmental challenges will be a continuation of the same challenges facing us now. Cleaning up our environment is not something accomplished in a short time. It takes years and in some cases (such as building up the systems to adequately treat and dispose of our sewerage) it takes decades. This part of the report considers the most pressing problems that are with us now and will stay with us for some indeterminable time in the future.

In some situations such as solid waste management, we can safely predict future needs for reclamation and disposal facilities and have made recommendations in those areas. The future of course will present problems unknown at this time. We can, however, improve the processes of managing our environment and in that way be in a better position to be responsive to future environmental issues as they occur.

Part III includes a description of issues that challenge us now and will continue to challenge us in the future. Recommendations are made under the following subject areas.

1. Sustaining Delaware's Air Quality
2. Protecting Our Water Resources
3. Managing Delaware's Wastes
4. Protecting our Fragile Ecosystems
5. Protecting our Shoreline
6. Agricultural Lands and the Environment
7. Protecting our Historic and Archaeological Resources
8. Open Space and Recreation

There is no implied priority in the sequence that these subjects are presented as the importance of issues varies from subject area to subject area.



# SUSTAINING DELAWARE'S AIR QUALITY

## INTRODUCTION

Many Americans can remember a time when urban areas were perpetually enveloped in smoky haze as industries discharged pollutants into the air with few or no controls. In some parts of the country people were occasionally hospitalized and some died. Although things have vastly improved over the years, particularly since the passage of the Clean Air Act in 1967, a number of serious problems remain.

Since Delaware first established air pollution control regulations in 1968, considerable efforts to improve the state's air quality have been made. Strong enforcement during the 1970's resulted in substantial emission reductions from heavy industries and utilities. Major pollutants, including sulfur dioxide and suspended particulates have been significantly reduced and are controlled at levels that more than meet national public health and environmental standards. Figure 16 graphically illustrates this progress.

Although considerable progress has been made in controlling the traditional air pollutants and increased attention given to toxics, ozone, indoor air pollution, acid rain, noise and odors, a return to pristine air quality is highly unlikely. If the overall level of air quality we enjoy today can be sustained as the state's population and economy grow, we will have made a significant achievement.

## THE KEY AIR QUALITY ISSUES

Of all the air quality concerns which demand attention in the coming years, four priority issues stand out: (1) lower atmospheric ozone, (2) toxic air contaminants, (3) indoor air pollution, and (4) acid rain. These four issues are particularly complex and have a number of common characteristics. To deal with them will require a strategy that goes beyond the regulatory process, a commitment of considerable resources and very likely some changes that will affect all Delawareans. Such changes may include limitations on motor vehicle use, the introduction of alternative transportation modes, restrictions on certain building materials, prohibition on smoking in public buildings, and the installation of pollution controls on wood stoves, fireplaces and other heating devices. Clearly, an informed public will be a necessary and important participant in affecting any changes that become necessary.

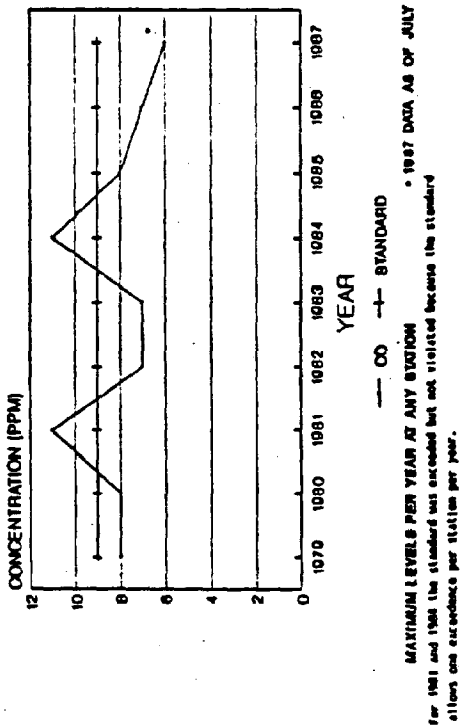
Most of these key issues call for a regional rather than a single state approach to air quality management, challenging neighbor states as well as Delaware to cooperatively work towards solutions.

### The Control of Lower Atmospheric Ozone

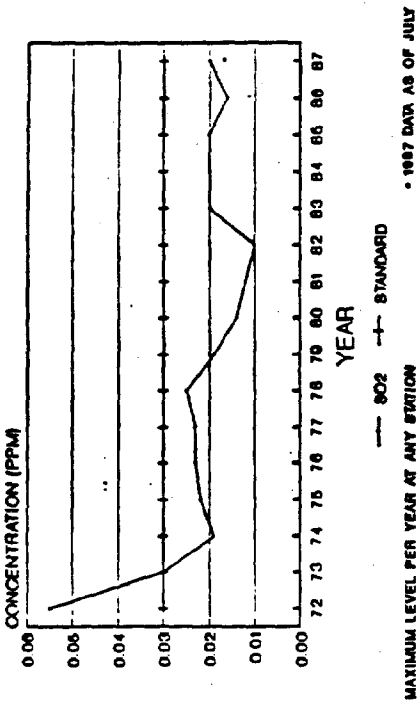
Ozone, the major component of smog, is produced when sunlight triggers a chemical reaction involving nitrogen oxides and volatile organic compounds (VOC's). Those compounds (ozone precursor pollutants) are produced by a number of sources including chemical plants, refineries, dry cleaners, and gas stations. The greatest man induced contributor to ozone, however, is automobile emissions. High levels of ozone can impair breathing, irritate the eyes, nose and throat, reduce visibility and damage crops, other vegetation and

Figure 16

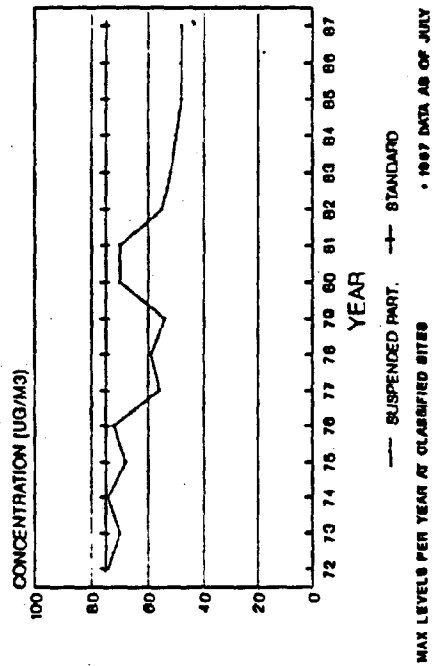
# CARBON MONOXIDE EIGHT HOUR AVERAGE



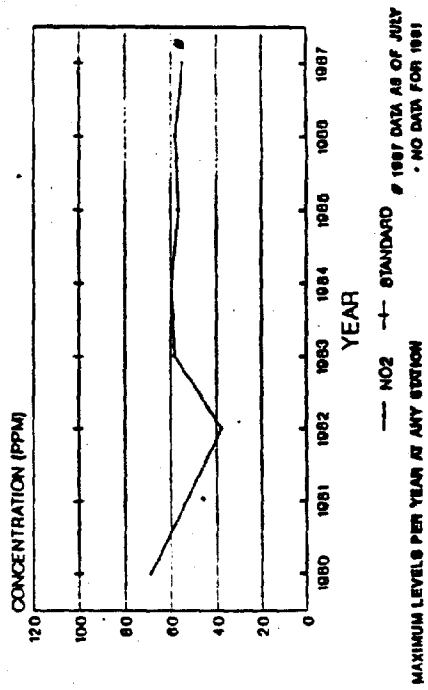
# SULFUR DIOXIDE ANNUAL ARITHMETIC MEAN



# TOTAL SUSPENDED PARTICULATE ANNUAL GEOMETRIC MEAN



# NITROGEN DIOXIDE ANNUAL ARITHMETIC MEAN



Source: Department of Natural Resources and Environmental Control

wildlife. Although considerable national emphasis has been placed on reducing ozone levels, controlling the major precursor pollutants is difficult because their sources are varied and widely dispersed.

Ozone is one of six pollutants for which the EPA has set national air quality standards. The Clean Air Act requires states to achieve the national standard (0.12 parts per million) by December 31, 1987. Compliance with the standard is measured over three-year periods in which localities are allowed three days of readings above the standard before a violation is registered. It is clear, however, that despite very concentrated control measures, Delaware and many other states are not likely to achieve the standard by that deadline. The concentrations of ozone in New Castle County, where the standard has not been met, have been continuously monitored at Claymont and Lindamere since 1979 and at Lum's Pond since 1981. For each of the three years 1984, 1985, 1986, the maximum hourly ozone concentrations have surpassed the standard on five, eight and six days respectively, exceeding the criteria (See Figure 17). In Kent and Sussex Counties ozone remains only marginally within limits.

EPA's strategy for reducing ozone levels in the lower atmosphere has focused on the reduction of VOC's. Although VOC emission reductions have been sufficient to allow a limited amount of new source emissions, this "growth" allowance<sup>1</sup> is nearly depleted and Delaware may soon have to restrict further industrial VOC sources. Despite a motor vehicle emission control inspection program in New Castle County and controls on major industrial hydrocarbon emission sources, northern Delaware remains out of compliance with the national standard.

The EPA, with the assistance of the State, is developing a strategy for areas unlikely to meet the national standard by the December 31, 1987 deadline. For example, EPA is conducting a modeling program to predict ozone reductions that can be compared to measured ozone concentrations. It is likely that this strategy will require more restrictions on existing sources, the possible control of small stationary sources (which are currently uncontrolled for VOC emissions), and more stringent restrictions on motor vehicle emissions.

The ozone issue in Delaware is compounded by the likelihood that some of the state's ozone problem is caused by upwind, out of state sources. This factor may significantly affect the state's ability to achieve and maintain the national standard. Delaware, in turn, potentially affects ozone pollution in downwind states.

Although the State lacks the capability to judge its toxicological basis, the suitability of the standard is, nevertheless, highly questioned. In effect the standard says that ozone presents a significant threat to public health and the environment for as little as one hour in an entire year. There is considerable debate regarding the appropriate "safe" dosage of ozone, and it would seem that a more realistic standard should be based on less conservative criteria.

<sup>1</sup>currently 354 tons of VOC emissions for New Castle County - a dry cleaning plant emits, for example, about 4 tons per year while the General Motors plant emits about 2500 tons per year with industries such as Standard Chlorine and Georgia Gulf emitting around 60 and 95 tons per year respectively.

# ANNUAL EXCEEDANCES PER MONITORING SITE NEW CASTLE COUNTY

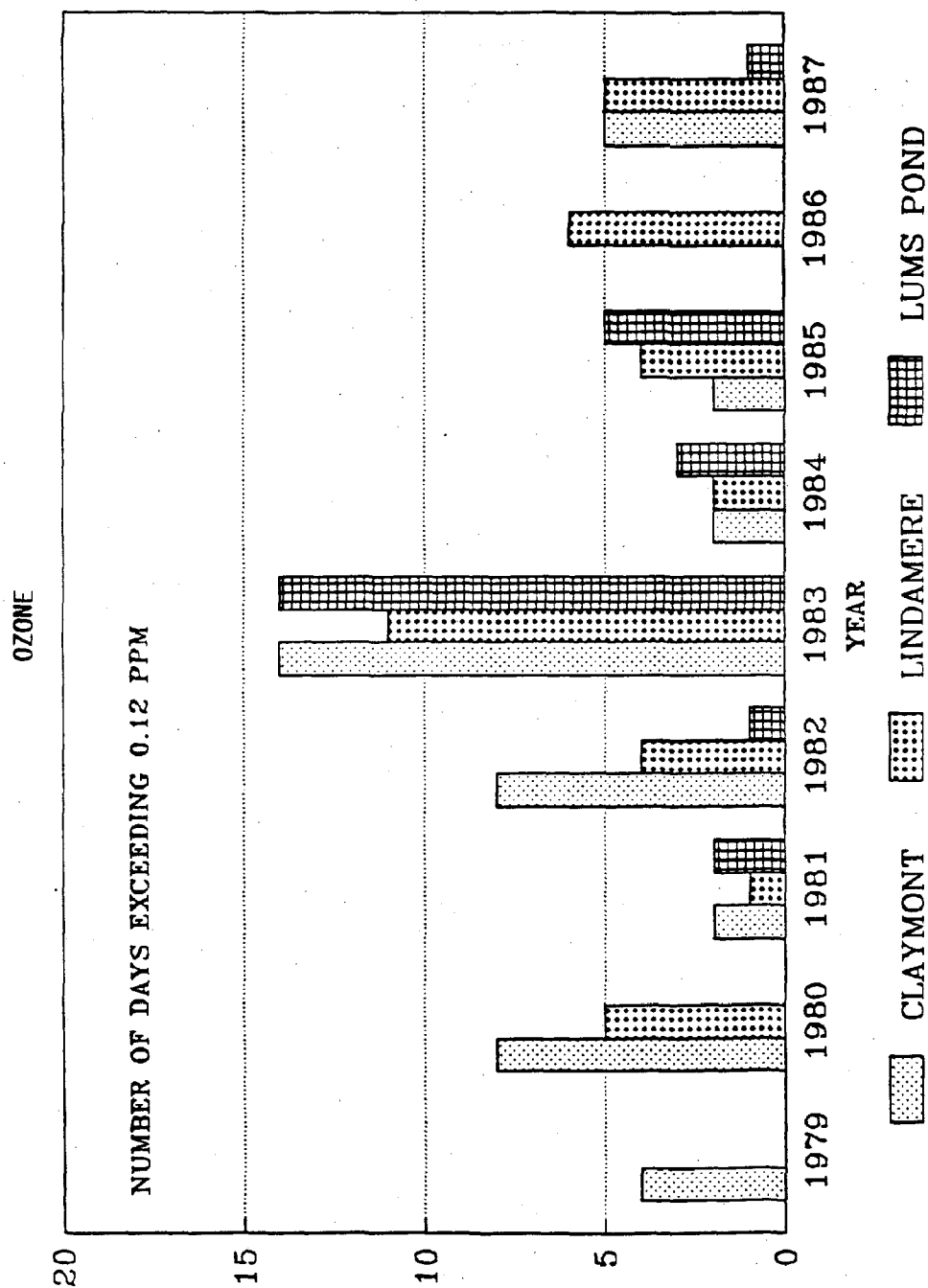


Figure 17

Source: Department of Natural Resources and Environmental Control

## RECOMMENDATIONS

- RECOMMENDATION 1. THE PUBLIC MUST BE INFORMED OF THE SIGNIFICANCE OF MEETING THE OZONE STANDARD. Since it is unlikely that Delaware will achieve the national ozone standard by the December 31, 1987 deadline, additional state and national actions to further control VOC emissions and meet the standard may be required. Such actions could include additional automobile "onboard" controls, refueling pump devices to prevent vapors from escaping into the atmosphere, gasoline vapor pressure limitations, traffic restrictions, alternative transportation modes, restrictions on water and wastewater treatment and disposal facilities and restricted use of certain paints, adhesives and solvents. In addition, the siting or expansion of industries that emit ozone precursor pollutants in New Castle County may have to be constrained.

Clearly, a well organized public education process is needed to help make citizens and decision-makers aware of the impacts and tradeoffs that would accompany adoption of additional control measures needed to meet the national standard.

- RECOMMENDATION 2. DELAWARE SHOULD AGGRESSIVELY PUSH FOR THE U.S. CONGRESS TO TAKE ACTION TO PROMOTE REGIONAL COMPACTS FOR SOLVING THE OZONE PROBLEM. Northern Delaware air quality and meteorology have traditionally been associated with the Philadelphia/New Jersey metropolitan area. However, Delaware's location and size, prevailing winds (see Figure 1) and the time-delayed photochemistry of ozone call for a different approach to air quality management. Although the precise amount of ozone coming into Delaware from upwind states is unknown, the probable influence of the Baltimore/Washington metropolitan area on Delaware's air quality argues for a regional solution to the problem. Delaware will also have to consider any contribution it makes to ozone levels in New Jersey and, perhaps, other downwind states.

In addition, Delaware should urge Congress to take the necessary actions to ensure regional solutions to the ozone problem are carried out.

- RECOMMENDATION 3. SUFFICIENT AIR MONITORING CAPABILITY MUST BE ACHIEVED. Because the nature of ozone generation and transport oversteps a single state's boundaries, Delaware must be able to determine the extent of ozone transported into the state from upwind sources. Consequently, the state must expand its air monitoring capabilities, particularly in Kent and Sussex Counties where the existing capability is meager. Once this has been achieved, several years of data will be needed to accurately determine the effects of interstate ozone transport on Delaware's air quality.

## Toxic Air Pollutants

One of the most difficult environmental problems confronting Delaware is controlling air toxics. Only in the past few years have we become aware of the plethora of potential toxic substances present in the air. Unlike the other air pollutants, toxics include a great number of chemicals, health effects data is limited and with many toxics few threshold or safe levels have been determined.

Toxic air pollutants are emitted from a variety of sources including industrial and manufacturing processes, solvents, sewage treatment plants, hazardous waste handling and fuel combustion. While EPA has established some standards for hazardous air pollutants, regulations for only six have been promulgated<sup>2</sup>. Much of the responsibility for achieving and enforcing standards has been shifted to the states where little or no uniformity exists among state control programs.

The biggest obstacle in controlling air toxics is the virtual absence of information concerning the health and environmental effects at the levels found in the ambient air. Although it is believed that many pollutants have serious effects on human health after long-term exposure, states have found it extremely difficult to set meaningful health standards based on those (incomplete) evaluations. Figure 18 shows sources of hazardous pollutants with established emission standards.

Delaware has begun to develop an air toxics control strategy, the first part of which will consist of a toxic emissions inventory. The second component of the strategy will require continued monitoring and the development of control standards.

As more data concerning the health risks of air toxics is made available, it is likely that more restrictive control of toxic emissions will be necessary. Should even the best emissions control technology prove insufficient to reduce toxic exposures, substantial restrictions on emission sources may be necessary. Restrictions may apply to such sources as coal, oil, or gas fired plants and incinerators as well as smaller contributors like wood burning stoves and motor vehicles. Restrictions on these sources may very well require changes in the way Delaware citizens are accustomed to living.

### RECOMMENDATION

COMPLETE AND IMPLEMENT A STATE TOXICS CONTROL STRATEGY/CONSISTING OF THE FOLLOWING COMPONENTS.

- a. An inventory of toxic air pollutants emitted in Delaware which will serve as a data base and determine what additional research and monitoring should be conducted. A review of existing air quality permits will provide additional technical information on the type and quantity of emissions currently allowed throughout the state. Completion of the inventory will be a necessary step before the control program can be effectively developed.

<sup>2</sup>Asbestos, mercury, beryllium, vinyl chloride, benzene, radionuclides and arsenic.

FIGURE 18

SOURCES OF HAZARDOUS (TOXIC) POLLUTANTS WITH ESTABLISHED  
EMISSIONS STANDARDS

Pollutant	Source
Asbestos	Asbestos mills, road surfacing with asbestos tailings, manufacturers of asbestos-containing products (fireproofing, etc.), demolition of old buildings, spray insulation.
Beryllium	Extraction plants, ceramic manufacturers, foundries, incinerators, rocket motor manufacturing operations.
Mercury	Ore processing, chlor-alkalai manufacturing, sludge dryers and incinerators.
Vinyl chloride	Ethylene dichloride manufacturers, vinyl chloride manufacturers, polyvinyl chloride manufacturers.

Source: Information provided by the U.S. Environmental Protection Agency.

- b. An effective state air toxics monitoring, research and data analysis program. Monitoring, research, data analysis, and the sophisticated equipment necessary for testing, monitoring, and risk determination must be components of this program.
- c. Enhanced scientific/technological capability must be developed to effectively address air toxic issues. Medical, scientific, engineering, toxicological, economic, and educational expertise must be available to environmental managers to effectively deal with this problem. To achieve that objective it is recommended in Part IV of this report that a scientific/technological advisory body be created to provide enhanced scientific/technological capability to environmental managers and to assist in communicating complex technological matters to the public.

Technical areas that initially need to be addressed include:

1. The process of adopting air quality standards for several toxic air pollutants listed but not promulgated by EPA.
  2. Re-evaluation of the 10 pound per day emission permit exemption for known carcinogens.
  3. Selection of best available technology to control emissions for known carcinogens.
  4. Selection of emission standards for known carcinogens using conservative safety factors.
  5. Establishment of requirements for leak detection programs for industries which use toxic substances.
  6. Establishment of more stringent control methods including incineration of toxic emissions.
  7. The effect of toxic air emissions from wastewater treatment facilities.
- d. An improved level of coordination with other states and the EPA to foster more timely development of EPA's programs for listing and regulating toxic air pollutants and for air toxics research, particularly research on toxicology. EPA has provided little oversight or guidance regarding state air toxic control programs and its process for listing and regulating toxic air pollutants has been slow. Like many other states, particularly small states with limited capabilities, Delaware is not likely to be a leader in terms of air toxics research and standard setting. As a result, the state should join with other states to urge the EPA to expand and accelerate the national program



for listing and regulating toxic air pollutants and should work together to develop a more coordinated air toxics control strategy. The state, however, should marshal sufficient scientific/technological resources to develop a limited research capability of its own.

## Indoor Air Pollution

Air pollution is not exclusively an outdoor problem. Nitrogen oxide, carbon monoxide, formaldehyde, radon gas, asbestos, tobacco smoke and other pollutants can be found indoors in concentrations which are often far greater than those found outdoors. Since most people spend about 90 percent of their lives indoors, high concentrations of these pollutants may present serious health risks.

The extent of indoor air pollution is largely unknown but several factors indicate the problem has worsened in recent years. Energy conservation measures (e.g. sealing cracks, installing insulation) which are intended to reduce the escape of air also trap air pollutants inside. The use of synthetic chemicals such as formaldehyde and volatile organic resins in building materials, furniture, and household products have introduced more pollutants in the home and workplace. Moreover, the popularity of heating with kerosene and wood increases the potential for pollutant build up. Radon, although not a problem in Delaware today, nevertheless, should continue to be monitored to ensure that it doesn't become a problem.

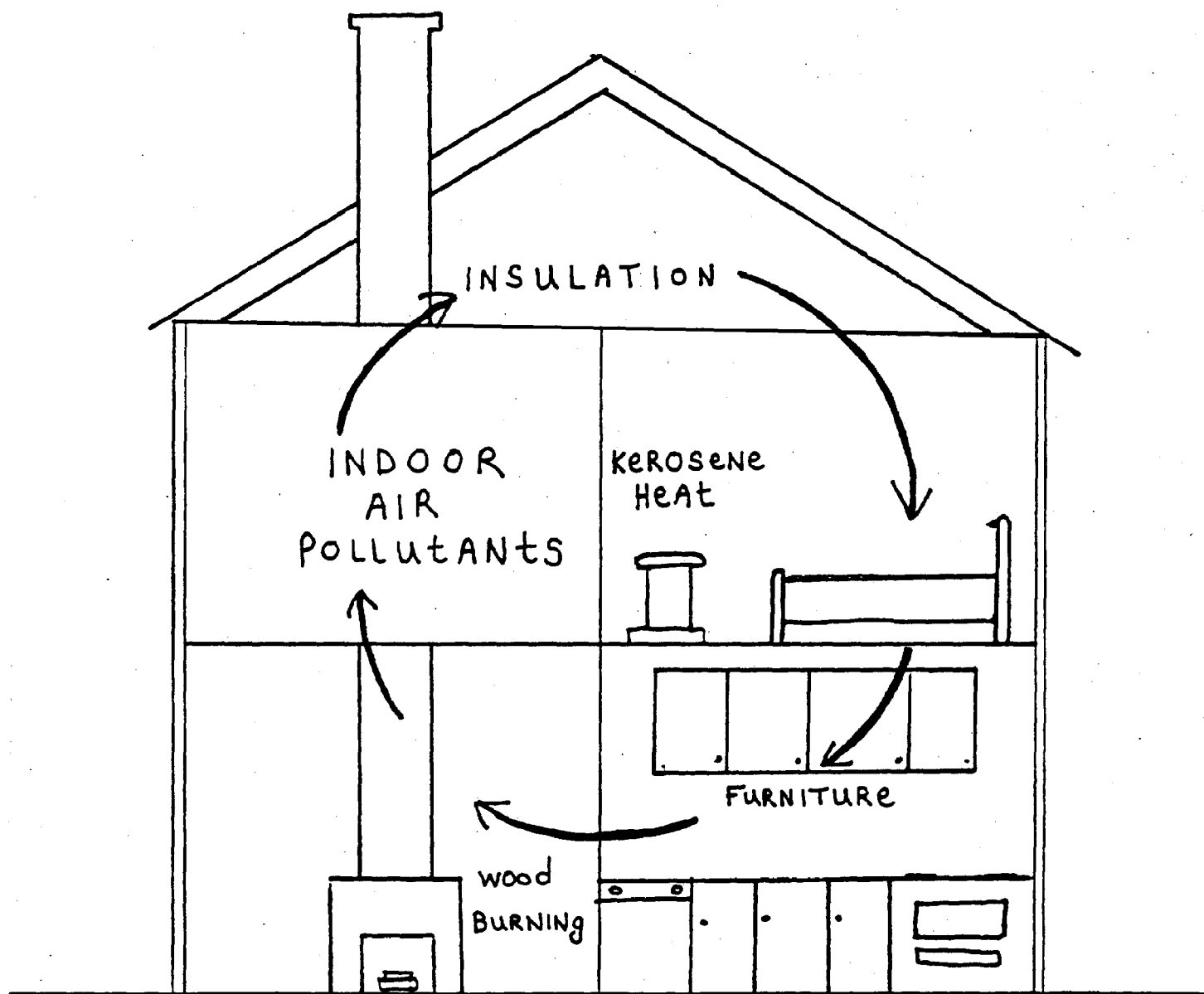
Although no indoor air quality monitoring program exists in the country comparable to those for outdoor air, Delaware has established a limited effort, coordinated among the Departments of Health and Social Services, Natural Resources and Environmental Control, Agriculture and Labor. Through this arrangement Division of Public Health is given major responsibilities which include the inspection, investigation and monitoring of indoor air quality upon request. However, no single agency is assigned to manage a comprehensive statewide indoor air quality program in Delaware.

### RECOMMENDATION

THE BUREAU OF ENVIRONMENTAL HEALTH IN THE DIVISION OF PUBLIC HEALTH SHOULD BE GIVEN RESPONSIBILITY TO ESTABLISH AND COORDINATE A COMPREHENSIVE STATEWIDE INDOOR AIR QUALITY PROGRAM. Statutory authority and sufficient resources to develop and implement a program should be provided. The Program should focus on preventative efforts including:

- a. Public awareness.
- b. Greater uniformity in building codes to ensure adequate ventilation and circulation.
- c. Legislation to address specific indoor air quality issues such as restricting particular building practices and materials typically associated with serious indoor air quality problems, requiring emission control devices when using certain fuels in the home or prohibiting smoking in public buildings. In addition, the program should provide the capability to monitor (upon request) private homes and public buildings for indoor air quality problems and to assess the health risk of high concentrations of pollutants.

Figure 19  
SOURCES OF INDOOR  
AIR POLLUTION



Source: Michael Taylor

## Acid Rain

Although it has not shown itself to be a significant problem in Delaware today, acid rain (or acid deposition as it is more formally called) is a threat that bears watching.

Acid rain results when oxide gases, released by combustion, combine in the atmosphere with water vapor and are hydrolyzed to become acids. The acidified vapor is carried by the winds and may come to earth hundreds of miles from the source of the contamination.

In addition to reducing pH readings in water to levels that jeopardize aquatic life, toxic metals such as lead, mercury, cadmium, aluminum, zinc, beryllium, and nickel can be released by acid rain from lake bottom sediments and leached from surrounding soils. High concentrations of aluminum in lake water can lead to fish mortality. Furthermore, rain falling through polluted air scavenges particles which may contain toxic substances, thereby further degrading surface water quality.

Little is known about the effect of acid rain on trees, plants, and croplands although studies are being conducted in all these areas. Although a certain amount of acid in the soil is necessary for agriculture productivity, too much can cause problems. Acid rain for example has been blamed for killing trees in eastern Europe. Its threat to aquatic communities, however, is well understood. The pH levels of most healthy lakes are usually in the range of 6 to 8. When these levels begin to drop because of acid rain, the effects may be dramatic. Some species such as the striped bass are believed to be directly affected by acid rain in Delaware.

In an ecosystem, damage to one element signals trouble for the entire chain of life. At pH 6.6, most freshwater snails do not survive and the eggs of certain salamanders fail to hatch. Tadpoles and shrimp die in waters below pH 6.0. Many species of microscopic zooplankton and phytoplankton, which form the lowest rungs of the food chain, die out as the pH level continues to drop. When pH slips below 5.5, northern pike, perch, and other fishes disappear. Species die out for two reasons: either adult fish die or eggs fail to hatch. When pH levels reach 4.5 in lakes, most frogs and insects, and all fish are dead, and acid-loving plants, take over.

DNREC has been measuring a number of chemical parameters for rainfall collected at sampling stations in Newark and Edgemoor. Researchers at the University of Delaware-College of Marine Studies also have analyzed the chemistry of rainfall in the marine environment of Lewes. Although no studies solely related to the effects of acid rain on Delaware surface and ground waters have been carried out, examination of chemical data collected from these waters can point to potentially troublesome areas.

A comprehensive "Survey and Classification of Delaware's Public Lakes" was completed in 1981. Water quality data were collected for 30 impoundments and an attempt made to rank the lakes as to their susceptibility to damage from acid rain.

The acid rain problem is linked with ozone in that resolution of the issue is beyond the control of Delaware. A national initiative is necessary to effectively deal with it.

## RECOMMENDATIONS

- RECOMMENDATION 1. DELAWARE SHOULD AGGRESSIVELY URGE THE U.S. CONGRESS TO DEVELOP LEGISLATION OR OTHER MEANS TO PROTECT THE STATE FROM ACID PRECIPITATION INDUCED BY UPWIND STATES.
- RECOMMENDATION 2. A LONG TERM PROGRAM SHOULD BE CARRIED OUT TO MONITOR THE ACIDITY AND RESULTANT AFFECTS ON AQUATIC COMMUNITIES ON THE STATES MOST SUSCEPTIBLE WATER BODIES.

## **OTHER RECOMMENDATIONS**

- RECOMMENDATION 1. APPROPRIATE LOCAL JURISDICTIONS WITH THE ASSISTANCE OF THE STATE, SHOULD DEVELOP ALERT AND EVACUATION PLANS IN EVENT OF THE RELEASE OF DANGEROUS EMISSIONS OF AIR TOXICS.
- RECOMMENDATION 2. THE STATE SHOULD TAKE ACTIONS TO CONTROL OFFENSIVE EMISSIONS FROM DIESEL POWERED VEHICLES.

# PROTECTING OUR WATER RESOURCES

## INTRODUCTION

Although three quarters of the earth's surface is covered with water, only a small percentage is available for our use. Ninety seven percent of the world's supply is salt water with the remaining three percent freshwater found in polar ice, atmospheric and soil moisture, rivers and streams and the ground.

Water follows a cycle (Figure 20). It comes to earth as precipitation where it is then stored in oceans, lakes, rivers and streams and below the earth's surface. There it is used for drinking, bathing, and recreation; to turn turbines and convey wastes; and as a habitat for plants and animals. Some water evaporates back to the atmosphere and in due time falls again to the earth, continuing the cycle. At each stage of the cycle water is vulnerable to contamination. In addition, local interruptions in the cycle can result in a shortage of water.

Everything in Delaware is strongly influenced by water. About 500 miles of rivers and streams, 1,500 acres of ponds, 165 square miles of marsh and wetlands, and 380 miles of coastline are contained in Delaware's 2,000 square mile area. The Delaware Bay, which washes most of the state's eastern shore is more than one-third the size of Delaware in land area. While surface streams in populous northern Delaware provide the main source of potable water, vast supplies of groundwater provide billions of gallons each year for use throughout the state.

Assuring adequate supplies of safe, quality drinking water will be more difficult to achieve in the future as declining open space, increased demand and rising population strains the earth's natural capacity to generate fresh supplies.

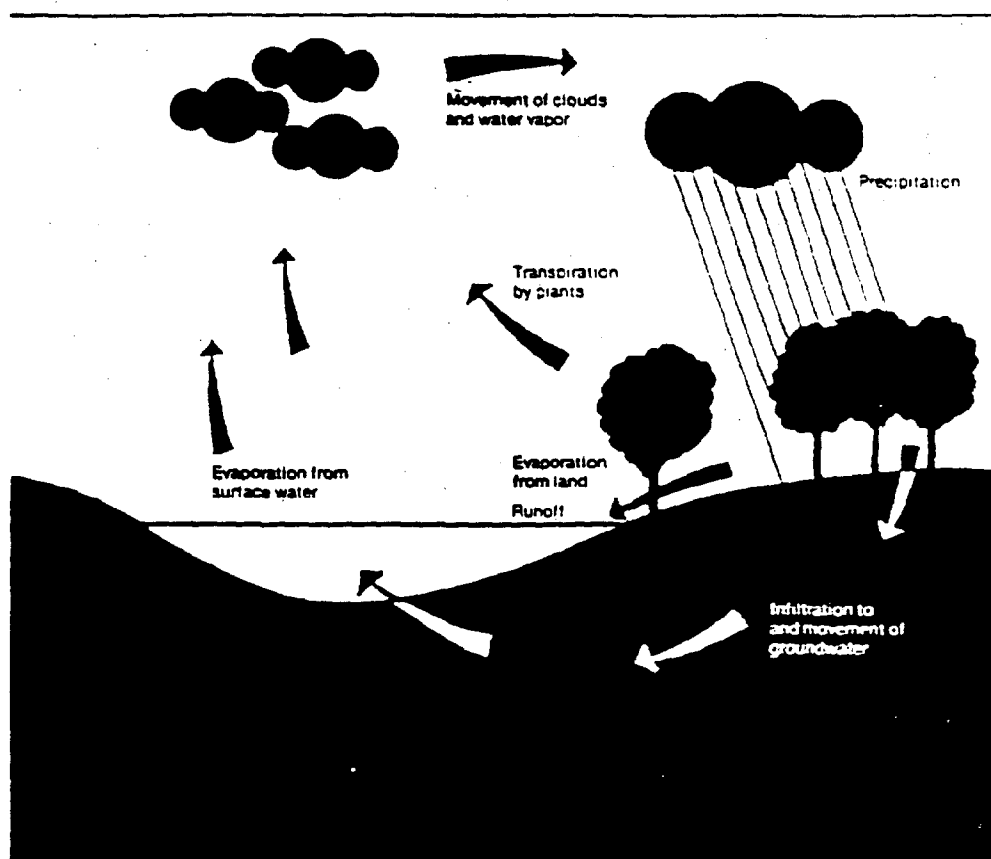
Water is such a pervasive component of our environment that it is impossible to thoroughly discuss it in any one section of this report. For example, acid rain, an air quality matter, only becomes a problem when it settles on our lakes and ponds; poorly managed waste disposal will pollute groundwater; industrial, commercial, agricultural, and residential land uses can adversely affect the quantity and quality of water supplies, natural phenomena such as sea level rise and drought also effect our water resources. Consequently, a thorough appreciation of the state's key water related issues can only be had by examining this report in its entirety.

## THE KEY WATER RESOURCES ISSUES

### Aquifer Recharge and Protection

Unless rainfall is able to infiltrate the ground on a continual basis, groundwater aquifers (underground repositories of water) will be depleted. Aquifers also provide the conduit for water to reach freshwater lakes and streams. In Delaware, groundwater recharge averages about 14 inches per year or over a half million gallons per square mile per day. This amount varies from year to year with the amount, intensity and seasonal distribution of precipitation and by locality as governed by the land slope, cover and nature of the soils.

Figure 20  
The Hydrologic Cycle



Source: Basic Ground-Water Hydrology

Recharge is lost primarily through storm and sanitary sewers as urbanization replaces open space. In urban areas artificial recharge (i.e. retention basins) can be employed to maintain groundwater quantity; however they often serve merely to lessen surface runoff peaks and are generally not designed to recharge groundwater. Artificial recharge has often been advocated, especially for New Castle County, but few serious efforts have been made to employ it. Preserving strategically located open lands from certain types of development and controlling development in the vicinity of wells are two methods to assure adequate aquifer recharge in the future.

Because of abundant supplies and few cases of public water supply contamination, Delaware has made no attempt to protect aquifer recharge from urbanization. However, New Castle County, working with the Delaware Geological Survey and the DNREC has developed measures to protect wellhead areas from hazardous wastes, and a program for wellhead protection will soon be developed by the state. Wellhead protection requirements will be controversial and will take time to implement. Wellhead protection involves only the protection of existing wells. Establishing groundwater preserves or employing land use controls to assure aquifer recharge in protection areas, however, protects both present and future water supplies. Water resource protection areas identify locations of valuable and vulnerable aquifer systems so that development may be restricted or adjusted for protection of the resource. Preserves are areas (defined by productive aquifers containing high-quality water) set aside to preserve the water resources for future use, especially in case of catastrophic loss of existing sources. The difference is inherent in the concepts of "protection" as opposed to "preservation."

The question of how much area should be protected to assure sufficient recharge is a difficult one to answer. However, one could roughly determine the overall area needed by making the following calculation.

Assume 1 billion gallons a day is the total amount of groundwater available statewide and that daily withdrawals of up to 350 million gallons would be replenished by recharge. Then, assuming 200 mgd is the current use of groundwater in Delaware, 200 square miles of recharge area, where recharge takes place at a rate of 1 mgd per square mile, would be needed to meet current demand. For a reserve contingency of 25%, 50 square miles (or 32,000 acres) would provide a 50 mgd reserve.

RECOMMENDATION:      SIGNIFICANT AQUIFER RECHARGE AREAS THROUGHOUT THE STATE SHOULD BE DELINEATED AND PROTECTED FROM DEVELOPMENT AND OTHER ACTIVITIES THAT POSE SERIOUS THREATS TO GROUNDWATER QUALITY. IMPLEMENTATION OF THIS RECOMMENDATION MUST BE A JOINT STATE/LOCAL RESPONSIBILITY.

- a. Local governments within the framework of state adopted standards should provide sufficient restrictions in land use planning and development policies and regulations including codes requiring maintenance of recharge rates.
- b. The state through the Delaware Geologic survey and DNREC should provide local governments the information needed to make those land use planning and development decisions.

- c. The state should also designate state owned lands in open space as ground water preserves and limit development on those lands to that compatible with the current use.
- d. Legislation should be adopted outlining the responsibilities of private landowners in protecting wellheads and aquifer recharge areas consistent with land use controls.
- e. A strategic plan should be developed to identify areas which should be designated as aquifer recharge areas and additional research to study the optimum location and characteristics of other recharge sites which may be needed in the future, should be conducted.

## Water Supply and Demand Management

Although Delaware is relatively rich in water resources, those waters are not uniformly distributed in space or time. It does not always rain when rain is needed and development does not always take place where aquifers are present to support water demand. Overall, the demand for water may be considered proportional to population; the growth in population is easily measured and clearly indicates pressure on water supplies. At the same time, development reduces the available water supply by increasing runoff, preempting desirable sites for water production, and introducing sources of contamination. Moreover, the natural quality of water is not always exactly that desired for a specific use. Accordingly, careful attention must be paid to supply and demand management.

### Supply Management

Regionalization and facility optimization are two concepts reflected in state water supply management policy since it is usually in the public interest to have regional water supply and distribution systems rather than allow the proliferation of small, individual facilities. Advantages include:

- a. Supplies can be shared (to overcome local system limitations) to protect against water shortage;
- b. Helps balance supply and demand;
- c. Encourages economy of scale, professional management and efficient use of the resource; and
- d. Minimizes the costs to rate payers.

Regionalization and facility optimization of water supplies is important in New Castle County north of the Chesapeake and Delaware Canal where more than 80 percent of the potable water is provided by five municipal or investor owned water utilities. It is also very important in Coastal Delaware where the potential for proliferation of small systems and franchise areas is great.

State and local water resource agencies have been encouraging regionalization and supply optimization for some time. The Water Resources Agency for New Castle County (in its Water 2000 program) demonstrated the feasibility of optimizing existing water capacities through interconnection and



transfer of water among utilities. The DNREC recently (March 1987) adopted water allocation regulations which, among other things, reiterated policy adopted in the 1983 Comprehensive Water Resources Management Plan to promote regionalization. DNREC has also adopted requirements for the creation of water service franchise areas which grant an exclusive right to provide public water service within a given area. These new requirements strengthened the public notification, bonding, and general application procedures and require the development of water service plans. Problems remain in obtaining utility service for new developments that are required to provide central water and are not located within a franchise area and in certifying existing privately owned public water systems. Many such systems exist, especially in trailer parks and smaller communities throughout Delaware. Regulation of those systems is needed as their ability to meet emergency needs and other regionalization goals is minimal.

RECOMMENDATION 1. PROVIDE THE NECESSARY RESOURCES FOR THE PROMOTION, CREATION AND EXPANSION OF CENTRALIZED, PUBLIC WATER SYSTEMS AND REQUIRE THEIR INTERCONNECTION.

This will require the adoption of regulations and a study to determine the extent of interconnection which is feasible. The state should closely supervise all water utilities to make sure their supplies are at all times sufficient.

RECOMMENDATION 2. REGIONALIZATION OF WATER SUPPLY FACILITIES AND FACILITY OPTIMIZATION SHOULD BE REQUIRED WHERE FEASIBLE AS A KEY STRATEGY IN ASSURING THE FUTURE AVAILABILITY OF WATER.

A risk assessment and emergency plan should be completed for New Castle County's public water supply network to identify critical facilities and establish operating plans/procedures to meet water needs under emergency conditions.

This strategy will be particularly important in the event of localized water shortages caused by contamination.

## Demand Management

Water demand management, a term which means reducing the use of water, can be separated into emergency or routine actions. The Department of Natural Resources and Environmental Control and the Delaware River Basin Commission are required by law to consider water conservation. Most demand management practices in Delaware are based on unwritten policies established after the basin-wide drought of 1980-81.

The Statewide Comprehensive Water Resources Management Plan addressed many aspects of drought management including the development of a drought index and the dissemination of water conservation information. The drought conditions experienced in Delaware in the last several years, however, have identified drought management areas that may not be adequately covered. Although the state has not experienced a widespread, supply-threatening drought, the recurrence of drought conditions throughout this decade, as well as the potential for water contamination and system failures, suggests the need to consider additional conservation and drought management strategies.

Aside from dealing with water emergencies there is a need to find ways to reduce per capita water demand. Probably the most effective way to reduce demand is by the use of water-saving plumbing devices and through public education. Changes in plumbing codes have been suggested, while water conservation education has generally been visible only during drought conditions.

**RECOMMENDATION**

**WATER DEMAND MANAGEMENT SHOULD BE IMPROVED BY:**

- a. REQUIRING THE INSTALLATION OF WATER SAVING PLUMBING FIXTURES IN ALL NEW BUILDINGS AND THOSE BEING REHABILITATED.
- b. DEVELOPING MORE FLEXIBLE AND ENFORCEABLE WATER USE RESTRICTIONS TO MEET THE SPECIFIC REQUIREMENTS OF WATER SHORTAGE OR DROUGHT CONDITIONS.

The objective would be to have at hand such measures as conservation plans, allocation priorities, pricing modifications, and penalties appropriate to anticipated emergencies. Allocation procedures should consider conservation areas and other natural resources.

- c. DEVELOPING A WATER CONSERVATION EDUCATION PROGRAM.

## **Financing Water Supply Infrastructure**

Almost all of the state's municipalities have central water supply systems, and most of them are very old. Many were installed in the 1920's and 1930's and may be in need of extensive maintenance or replacement. In many Delaware municipalities water systems supply only a few users and as a result water rates do not reflect the cost of service. Moreover, due to the ready availability and generally low cost of water, people tend to take liberal advantage of what is available at the tap.

Little or no federal support for water supply systems' construction or repair is available or anticipated. Because of the small rate base, municipalities cannot easily afford construction and repair costs and, traditionally, the state has not been in the business of providing funds for municipal water supply systems. However, no facility by facility needs study exists to gauge the extent of rehabilitation or repair needed for municipal systems.

## **New Castle County Systems**

New Castle County's Water 2000 Plan made recommendations regarding the need for financial assistance to develop major water facilities. In its report, volume VII: Future Water Supply Projects for Northern New Castle County, June, 1984, the county recommends that the state (and/or New Castle County) enter into negotiations with the landowners of the "Thompson Station Road site" to complete the acquisition and reservation of lands at the site in the White Clay Valley for a potential future reservoir. Additionally, the report recommends the acquisition of lands at the "Churchman's Marsh site" and the completion of an environmental impact statement to determine the suitability of that site for a

future reservoir should that option become viable. The state would participate along with other public and private entities in the funding of those activities. The Water 2000 report urges quick action on those recommendations.

## **Lower Delaware Public Water Systems**

State officials know very little about the condition of municipally-owned water systems in lower Delaware. This is because the state has no jurisdiction over these resources except to permit water wells and enforce certain health regulations. Because state jurisdiction is very limited, officials know only that the majority of Delaware's municipally-owned water systems were built prior to 1940 and that few, if any, systems have a sinking fund or other means to pay for new construction or rehabilitation.

Because of the lack of knowledge concerning these systems, meaningful state financing policy cannot be made. The condition of systems, cost of renovation, the demand for expansion and information on current rate structures are necessary.

The supply of safe, quality drinking water is critical to ensure public health. Municipal water utilities have generally proven to be a safe means of providing water supplies in urbanized areas. Further, the Safe Drinking Water Act encourages the attainment of water quality levels which may only be achieved through municipal systems. It is this concern that supports the following recommendations:

### RECOMMENDATIONS

- RECOMMENDATION 1. THE STATE SHOULD ADOPT A WATER SYSTEMS FINANCING POLICY BASED ON THE REQUIREMENT THAT ALL MUNICIPALITIES IMPLEMENT A SINKING FUND AND THAT STATE FINANCING BE BASED ON THE LOCAL GOVERNMENTS' ABILITY TO PAY.

The sinking fund requirement would encourage local governments to develop means of financing the rehabilitation or rebuilding of their systems based on user revenue. State financing should not occur unless the facility or its expansion are consistent with local land use plans and state standards. The state should provide staff assistance to help municipalities create fee schedules that include sinking funds and to help in the maintenance of these funds.

- RECOMMENDATION 2. WATER SUPPLY AND DISTRIBUTION SYSTEMS SHOULD BE PERIODICALLY EVALUATED TO ENSURE ADEQUATE QUANTITY AND QUALITY OF WATER IS DELIVERED.

This will require a study of the current water distribution system to determine the extent of needed repairs or rebuilding.

## **Threats to Water Quality**

Water quality, can be adversely impacted by a number of activities including on-site wastewater treatment and disposal, hazardous materials spills, leaks and other releases, solid waste disposal, land application of wastes, agricultural activities and salt water intrusion. A problem that will be particularly hard to deal with is the control of toxics in our water. The state

must clarify policy in protecting water resources from these threats. Protection of groundwater from contamination is particularly important since such effects are essentially permanent. Unlike surface water or the air shed, it takes a very long time for natural processes to flush, dilute or attenuate contaminants sufficient to make groundwater useful to man.

## **Toxic Substances in Surface and Ground Waters**

A substance is said to be toxic if it can cause biological damage upon contact with the surface or inside of a living organism. Toxicity, or the ability to injure, is generally categorized as either acute or chronic in nature. Acute effects occur in the short term, and include death as well as obvious physiological changes. Chronic effects occur over the longer term, and include the aforementioned consequences, plus other effects including carcinogenicity (cancer-causing), teratogenicity (damage to fetuses) and mutagenicity (genetic damage). Many of these effects are not seen until years after the initial exposure, and are thus difficult to correlate with the original cause.

Significant problems exist in handling the issue of toxics in surface and ground waters. Chemicals have toxic effects which vary from lifeform to lifeform and even individual to individual. Variations are also found depending upon the environmental conditions under which the lifeform is exposed to the toxic substance (time, concentration, other chemical and physical factors). Fate and transport of the substance are often poorly understood, as transformations can occur between the source and the receptor. In addition, the sources of toxic substances may not be identifiable, making control efforts impossible.

## **Sources**

The numerous potential sources of toxic pollutants make regulation difficult. Industrial discharges are generally thought of as the primary source of toxic pollutants, but publicly owned wastewater treatment works (POTW's) have also been demonstrated to be a significant source. Process wastewaters are major contributors of toxic pollutants from industrial facilities; stormwater contaminated on-site and cooling waters, treated with biocides to control biofouling, may also cause problems. POTW's that have significant industrial contributions should receive special attention as potential toxic sources, however, commercial and residential users may also be substantial contributors of toxic pollutants to POTW collection systems. Non-point sources of toxics include urban and agricultural runoff. Stormwater from urban areas has been found to be a major concern because of metals which result from traffic, sewer cross-connections, and poor practices with household chemicals by homeowners.

## **Fate, Transport and Exposure**

Substances transported in water can be ingested in several ways. The most common route of exposure may be the consumption of drinking water taken from "uncontrolled" sources (such as surface water supplies from free-flowing streams). Supplies affected would be the City of Wilmington (Brandywine Creek) and Wilmington Suburban (Red Clay and White Clay Creeks, Christina River). All waters taken from these streams are treated prior to release as "finished waters." Also at risk are large community supplies affected by landfill leachate or leaking storage tanks.

Substances can also be ingested through the consumption of contaminated fish or shellfish. Fish tissue is collected and analyzed for metals, pesticides, and volatile organic compounds on an annual basis for a minimum of five streams (Red Clay and Brandywine Creeks, Christina, Murderkill, and Indian River). Fish from other areas are collected on an as-needed basis. DNREC, in conjunction with the Division of Public Health, has posted advisories where risks of fish consumption were thought to be excessive (Red Clay and Red Lion Creeks).

Substance transmission modes which are probably of lesser overall importance are direct ingestion of surface water during recreational use, dermal (through-the-skin) transfer of substances carried by surface waters, and inhalation of aerosols.

### **Toxics Initiatives**

DNREC has in place a strategy designed to provide control of toxics in surface waters. As part of this effort, several research projects are underway. The results, produced over two years, will be used to strengthen the strategy.

#### **RECOMMENDATION**

STATE AGENCIES CHARGED WITH PUBLIC HEALTH PROTECTION SHOULD DEVELOP A COORDINATED PROGRAM TO MONITOR TOXICS IN THEIR AREA OF RESPONSIBILITY, OBTAIN AND EVALUATE SCIENTIFIC INFORMATION, PERFORM RISK ASSESSMENT, EVALUATE REMEDIES AND PROTECTIVE ACTIONS, AND DISSEMINATE FINDINGS AND RECOMMENDATIONS TO OTHER AGENCIES AND THE PUBLIC.

### **On-Site Sewage Treatment and Disposal**

On-site sewage systems have generally been used in suburban and rural areas of Delaware where distance and low housing density make public sewer systems too expensive to install. Systems installed in suburban areas, however, present potentially greater groundwater pollution and health risks than those located in rural areas because housing density is greater, reducing the capacity of the soils to treat effluent. The result is more people are exposed to health hazards and groundwater quality is deteriorated.

Beginning in 1980, the DNREC conducted a series of rural wastewater management and groundwater contamination studies which identified deficiencies in the way septic systems were regulated. New on-site wastewater treatment and disposal regulations were written and adopted in 1985. The new regulations provide for improved design standards, alternative disposal systems, professional site evaluation, subdivision review, hydrogeological studies, and larger lot sizes. By implementing professional site evaluation and subdivision review, the department has started to reduce some potential sources of groundwater contamination, especially in soils having insufficient capacity to treat effluent.

The important future issues the state may face in protecting groundwater from septic system contamination are system density in particular and rural wastewater management policy in general. The land market in many areas of the state is such that it would be uneconomical to develop land at very low densities, nor would it be prudent land use and fiscal policy to encourage large scale, low density development. The questions which then need to be addressed are:

- a. Should the state require all new or expanded subdivisions to have central wastewater treatment facilities?
- b. If so, how should they be managed and who should be responsible?
- c. Should the state designate certain areas where development pressure is significant and require the installation of public wastewater treatment systems as a condition to future development approval?

A major source of controversy concerning limits on septic system density is related to the distribution of costs and benefits and how they are perceived by those affected. The most obvious cost will be the loss in a landowner's property value when the amount of developable land or the allowable density of development on septic systems is reduced. On the other hand, the benefits of fewer septic systems will be in the form of better protection of groundwater quality, increased open space, and reduced costs for providing growth related services such as roads, utilities, schools and other public facilities. Equally important is the effect of minimizing the public costs of supplying problem areas with sewers and water.

The state must identify the circumstances under which septic systems pollute groundwater to an unacceptable level. It must decide at what development densities the environmental effects of septic systems would be tolerable, either on a permanent basis as in a rural area, or on a temporary basis until sewer service can be provided.

While septic systems for a suburban area might be less costly in the short run, they will almost inevitably be more expensive in the long term because of the high probability that public sewers or public water will eventually be needed. Thus, capital costs for waste treatment systems may have to be paid twice -- once for the septic system and again for the public sewer.

#### RECOMMENDATION

A GUIDING PRINCIPLE WHICH SHOULD GOVERN THE MANAGEMENT OF ON SITE SEWAGE TREATMENT AND DISPOSAL SHOULD BE THE PROTECTION OF GROUNDWATER FOR DRINKING AS WELL AS PROTECTION AGAINST SURFACE WATER POLLUTION FROM CONTAMINATED GROUNDWATER DISCHARGE.

Actions that should be considered in furthering this principle include the following.

- a. Require that all new or expanded subdivisions, above a certain number of lots, and of a certain density have central wastewater treatment systems. Studies should be conducted under present zoning regulations to determine the impact they have had on water conditions.
- b. Develop policy and regulations that require subdivisions recorded before April 1984, but where no substantial construction has yet occurred, to come under the auspices of the principles under (a) above. It is estimated that as many as 15,000 lots in Coastal Sussex County may be affected by this action.

- c. Require local governments to accept responsibility for management of privately owned on site sewage treatment facilities in the event that the private owners default on meeting the terms of his operating permit. Require suit of the responsible owner in event of default.
- d. Require the installation of public wastewater treatment systems in critical growth areas such as the inland bays as a condition to future development approval.

## **Hazardous Materials Releases**

Hazardous materials are defined as finished products or wastes that are ignitable, corrosive, reactive or toxic. These materials can be in the form of valuable commodities such as gasoline and pesticides or as waste products like dye, chemical containers, solvent wastes, oils, paint wastes and metal scraps. They can be found in landfills, surface impoundments, land treatment areas and storage tanks and may find their way into groundwater through accidents, corrosion of containers, and improper use. They can pollute groundwater with heavy metals, oils and volatile organic compounds. Among known or suspected cases of groundwater contamination are Delaware's 18 hazardous waste sites now being investigated under the national Superfund program. Most of these sites are in northern New Castle County.

Leaking underground storage tanks have recently been recognized as a widespread source of groundwater contamination, perhaps even a greater threat than the state's Superfund sites. Tanks for fuel storage buried in the 1940s or 1950s were generally made of steel and subject to corrosion in most soils. Over 200 of these underground tank systems have been documented to have leaked or spilled contaminating the groundwater with hydrocarbons and other toxic substances throughout the state. A new state law was passed in 1985 and regulations were adopted in 1986 to help deal with this issue.

A major problem in dealing with hazardous materials' releases is the high cost of cleanup. Although the General Assembly has appropriated a modest sum for hazardous waste site and spill cleanup, the potential costs to the state far exceed the money appropriated to date. In 1987 the General Assembly enacted a Leaking Underground Tank Trust Fund but no money has been authorized to deal with this near epidemic environmental problem. Recommendations dealing with this issue are contained in the Managing Delaware's Wastes section of this report.

## **Solid Waste Disposal**

The disposal of domestic garbage into landfills can pollute groundwater through the leaching of decomposed wastes. None of Delaware's older landfills were lined, therefore infiltration of leachate into groundwater has occurred at all of them. Delaware Solid Waste Authority state-of-the-art landfills and the closing of older landfills are key measures taken to mitigate the problem. Recommendations regarding the protection of groundwater from solid waste disposal can be found in the Managing Delaware's Wastes section of this report.

## Land Application of Wastewater and Wastewater Residuals

Land application of wastewater and wastewater residuals include processes such as spray irrigation, infiltration and percolation basins and sludge application to land. Sources of these wastes include municipal wastewater treatment plants, animal waste stockpiles, food processing operations and textile dyeing operations. These activities, if not properly controlled, can result in ground water becoming contaminated by nitrates, pathogens, toxics, salt, metals, and organic compounds. Although a few instances of contamination of domestic water wells from land application of wastes have been discovered in Delaware, most land application occurs away from inhabited areas. Recommendations related to this issue can be found in the Managing Delaware's Wastes section of this report.

## Agricultural Activities

Agricultural activities that lead to groundwater contamination include fertilizer and pesticide applications, animal feedlots and manure storage and disposal. These practices can result in nutrient, bacteria and sometimes toxic substance contamination in ground and surface waters. Best management practices are being developed to reduce pollution from commercial fertilizers and animal wastes. These practices save money for the farmer by reducing chemical use, thereby limiting pollutants. Additional discussion of these activities and recommendations can be found in the Agricultural Lands and the Environment and Managing Delaware's Wastes sections of this report.

## Saltwater Intrusion

Saltwater intrusion has been and continues to be a significant problem along the Atlantic coast, Delaware Bay and estuary, and the inland bays. Public water supply wells in or near Lewes, Rehoboth Beach, Bethany Beach, New Castle and on Long Neck have had to be abandoned as a result of saltwater intrusion and replaced by deeper wells or wells installed farther inland. As the population of the coastal area increases, water use will increase and with the increased effects of sea level rise the potential for saltwater contamination will in turn be greater.

RECOMMENDATION:      PROHIBIT THE INSTALLATION OF WELLS IN AREAS OF POTENTIAL SALTWATER INTRUSION.

Delaware should define these areas of potential saltwater intrusion and coordinate actions with other states, especially Maryland.

## Management of Risk for Water Contact Recreation

The lakes, ponds and inland bays of Delaware are heavily used for water contact sports such as swimming, boating, shell fishing, finfishing and other forms of recreation. The continuing attractiveness of these resources depends to a great extent on maintaining the "fishable-swimmable" quality of the waters. That quality has been difficult at times to maintain.

Recent attention to risk assessment, and in particular, risk to swimmers and others coming in contact with surface waters, has served to coalesce a number of efforts by various state agencies. For example, DNREC has funded, through the Inland Bays program, two studies related to recreational use of the bays. One study provided a preliminary management plan for recreational



suitability of the waters. The other study gives a cross-section of the different "users" of the bays -- what they do and want to do in the way of recreation and are willing to accept or pay for to protect those uses.

The DNREC has also revised its water quality standards to include improved bacteria standards and has designated a new protected use: high value recreational or ecological waters and has increased monitoring of the bays and freshwater lakes.

For the public beaches, more frequent sampling and more stringent standards are required to verify the continued safety of the waters for swimming, and to identify water quality changes which might impair the health of the public. Increasing the number of samples improves the accuracy of bacterial water quality estimates and improves the likelihood that accurate decisions on whether to close or leave open a beach are made.

#### RECOMMENDATION

RECOMMENDATION: PROTECTION OF THOSE USING DELAWARE'S WATER-BASED RECREATIONAL AREAS REQUIRES THAT:

- a. State agencies aggregate, evaluate, and utilize all existing information on water-based recreation use, public demands, water quality and related subjects.
- b. State agencies determine "high-use" areas which require formal management plans including water-use restrictions, monitoring and standards, action plans and public participation.
- c. Department of Natural Resources and Environmental Control establish a policy to implement the high value recreational or ecological waters protected uses established in the water quality standards for streams.
- d. Responsible agencies develop the necessary institutional arrangements to ensure that timely and appropriate action to respond to public health risks from water-contact recreation occurs.

### Stormwater Management

Urban development disturbs natural stormwater runoff patterns by replacing forest and fields with roads, buildings, and pavement. Urban runoff also may play a significant role in contributing to water quality problems. Runoff from commercial and industrial sites may yield heavy metals, microorganisms, sediment nutrients and organic materials.

Agriculture contributes pollutants from cropland, grasslands and livestock operations. Pollutants originating from agricultural practices include sediment, microorganisms, pesticides, nutrients, and organic materials. It has been estimated that agriculture contributes more than 50% of the sediment delivered to the nation's waterways.

Studies completed by EPA, the U.S. Department of Agriculture, and others show that it "pays to control nonpoint source pollution." For example, economic benefits can accrue to the farmer from reduced cultivation costs if conservation

tillage is employed as a means of controlling erosion. Additionally, offsite benefits, both direct and indirect, can accrue to local communities. For example, improved recreational opportunities and reduced dredging costs can result from decreasing siltation caused by runoff from nonpoint sources.

In silviculture, similar to agriculture, the major pollutant by volume is sediment. The same is true for construction activities, which while localized in nature, may result in severe water quality impacts.

Stormwater management was traditionally looked at as a means of drainage and flood control. In the seventies, stormwater management was, for the first time, considered a way to protect water quality. The trend to treat stormwater as a contamination source will have several effects, including the need for more expensive and elaborate stormwater controls, additions of new and revisions to existing stormwater ordinances, a shift of responsibilities from a public works to an environmental control orientation, facility maintenance, and the need for increased resources for technology transfer and cost-sharing of control techniques.

New Castle County and several municipalities require stormwater management plans to prevent downstream flooding. The other two counties and other municipalities have required some stormwater management on a case-by-case basis. The county conservation districts coordinate efforts to place conservation measures in urban and agricultural settings.

The key to careful targeting of control activities to maximize water quality benefits is a watershed-based analysis. A thorough watershed analysis will: (1) identify those problems that are caused specifically by nonpoint sources, (2) rank priority water bodies for concentrated attention, (3) pinpoint the specific land management practices causing the problems, (4) design a system of cost-effective management practices that can reduce the nonpoint source pollutant load to the watershed and be implementable in a timely fashion, and (5) be acceptable to the public and elected officials in the planning area.

The objectives of the watershed programs would be to reduce the water volumes and runoff velocities into waterways following storms and to reduce the amount of pollutants and contaminants associated with such flows. These objectives would be achieved by combining engineering methods with ecological concepts, creating environmentally sound storm water controls for all areas. Manuals detailing the practices and systems to consider for particular circumstances should be assembled and made available.

State programs to manage certain nonpoint sources currently rely heavily on voluntary education and training programs to encourage adoption of controls. While these voluntary programs have been around for a long time, the results appear spotty because there has not been a uniform, focused approach that targets resources to meet water quality objectives. Because of the diversity of options and the high public costs associated with implementing and enforcing nonpoint source control programs, supplements to voluntary programs must be carefully evaluated on the basis of need, social and economic equity, and effectiveness. Implementation of stormwater management programs may best be accomplished by personnel at the county or local level with state and federal agencies providing practice manuals, rules of practice, technology transfer and monetary assistance.

#### RECOMMENDATION

STORMWATER MANAGEMENT PROGRAMS SHOULD BE ESTABLISHED ON A STATEWIDE BASIS WITH STATE AND LOCAL GOVERNMENT COORDINATING ACTIVITIES. CONTROLS WOULD BE DESIGNED FOR PRIORITY PROBLEMS IN HIGH-VALUE BASINS UTILIZING A WATERSHED PLANNING APPROACH.

Best Management practices that should be considered for inclusion in such programs include the following:

- a. Decrease surface runoff volumes and velocities.
- b. Increase use of infiltration methods to handle surface storm waters.
- c. Increase use of vegetated swales and natural or artificial wetlands to retard discharges.
- d. Increase use of retention/detention basins to trap sediments and retard runoff volumes and velocities.
- e. Develop and implement new mosquito control practices to contend with detained urban surface waters.
- f. Promote flood prevention drainage only in those areas where public health, safety and welfare are clearly endangered.

### COMPREHENSIVE WATER QUALITY RECOMMENDATIONS

Additional policies and other means to manage Delaware's water resources now and in the future should be established and followed. The following recommendations are intended to serve that purpose.

#### RECOMMENDATIONS

RECOMMENDATION 1. THE STATE SHOULD ADOPT A NON-DEGRADATION WATER POLICY THAT ALLOWS FOR THE LAND DISPOSAL OF WASTES PROVIDED WATER QUALITY STANDARDS ARE MET.

RECOMMENDATION 2. WATER RESOURCE MANAGERS MUST BE PROVIDED ACCESS TO STATE-OF-THE-ART TECHNOLOGICAL INFORMATION AND EXPERTISE.

The recommended creation of a scientific advisory board (See Part IV of this report) and recommendation 4 below will aid in accomplishing this objective. The board should have as its initial charge the following water related responsibilities:

- a. Identification of the latest scientific research and theory.
- b. Development of strategies suitable to Delaware, addressing wellhead protection, aquifer recharge, groundwater research, remedial management and agricultural best management practices.

- c. Identification of appropriate organizations to provide specialized technological expertise.
- d. Assist in developing programs or regulations at state request.

RECOMMENDATION 3. FOR CONSUMER PROTECTION REQUIRE WATER SAMPLING AND ANALYSIS PRIOR TO SALE OF DEVELOPED REAL ESTATE UTILIZING ON SITE WELLS.

RECOMMENDATION 4. ESTABLISH DELAWARE POLICY ADVISORY BOARD FOR WATER RESOURCES.

The advisory board should be established by the governor and general assembly, include broad public and private representation and be charged with:

- a. Assisting with the development of an annual report documenting water conditions in Delaware and progress made towards resolving issues.
- b. Assisting in the development of state policies and strategies to improve water conditions, and
- c. Promoting coordination between water utilities, local governments, state government and the private sector for the purpose of carrying out state or federal policies or regulations.

RECOMMENDATION 5. THE DELAWARE STREAM WATCH PROGRAM SHOULD BE EXPANDED TO INCLUDE MONITORING OF ALL DELAWARE'S 36 MAJOR STREAM BASINS AND TO INVOLVE ALL OF THE STATE'S SCHOOL DISTRICTS.

The Delaware Stream Watch Program was established by the Delaware Nature Education Society (DNES) and DNREC in November 1985. The program is designed to improve water quality throughout the state by involving individuals, community organizations, and school groups in monitoring the health of Delaware's waterways. Stream Watchers "adopt" streams and use simple methods to determine the water quality and locate pollution sources.

Currently Stream Watch volunteers are monitoring 10 of Delaware's 36 major stream basins and the program has proved an effective means of detecting pollution problems.

# MANAGING DELAWARE'S WASTES

## INTRODUCTION

Waste is an inevitable product of our every day lives. If not properly disposed, even common household wastes can cause environmental problems ranging from foul smelling trash to breeding grounds for rats, flies, mosquitoes and other pests.

Small quantities of left-over chemicals in the home such as pesticides, wood preservatives, antifreeze, motor oils, paints and solvents are sometimes indiscriminantly dumped along with other, less harmful household wastes and end up contaminating groundwater.

Industrial wastes often present more serious problems. Many components of industrial wastes such as chlorinated hydrocarbons may be significant health threats in themselves. Other wastes may take on hazardous properties when mixed with different substances. Health effects from industrial hazardous wastes can range from headaches, nausea or skin rash to acid burns, serious damage to kidney and liver functions, cancer and genetic damage.

In the past decade or so, Delaware's responsibilities in waste management have grown tremendously. Only a few years ago conventional wastewater and solid waste disposal took all our attention. Today the State is involved in a wide variety of waste management programs including a major solid waste reclamation program, state-of-the-art landfill operations in each county; the regulation of hazardous waste transportation, storage and disposal; the investigation and costly clean-up of old hazardous waste sites; negotiations to dispose of our low level nuclear wastes out-of-state; the development of up-to-date regulations and management practices for the disposal of fly ash, PCB's, asbestos, infectious wastes, manure and other agricultural wastes, procedures for the pretreatment of noxious industrial wastewaters and innovative ways to dispose of wastewater on the land.

Several agencies and levels of government are involved in waste management. The Department of Natural Resources and Environmental Control is responsible for regulating solid and hazardous wastes and wastewater treatment and disposal while solid waste disposal and resource recovery is carried out by the Delaware Solid Waste Authority. A number of local, state, regional and federal agencies support the waste management effort in Delaware by providing technical and financial assistance.

## OVERALL WASTE MANAGEMENT STRATEGY

As Delaware's population and economy grows in the next few generations, we will, under present policies, be unable to safely dispose of all our wastes. Consequently, it is recommended that the state adopt a four step waste management strategy.

STEP 1 - REDUCE TO THE GREATEST EXTENT PRACTICABLE, THE PRODUCTION OF WASTES.

STEP 2 - FOR WASTES THAT CANNOT BE REDUCED AT THE SOURCE, RECLAIM OR REUSE TO THE MAXIMUM EXTENT PRACTICABLE INCLUDING RECLAMATION OF EXISTING LANDFILLS. PROVIDE FOR THE PROCESSING OF 100% OF MUNICIPAL SOLID WASTES THROUGH RECLAMATION FACILITIES BY THE YEAR 2000.

STEP 3 - FOR WASTES THAT CANNOT BE RECLAIMED OR REUSED AND FOR THE RESIDUALS OF THE RECLAMATION PROCESS ITSELF, PROVIDE ENVIRONMENTALLY SAFE DISPOSAL FACILITIES WITH INCINERATION AS THE PREFERRED MEANS OF DISPOSAL.

STEP 4 - FOR WASTEWATER RESIDUALS (NON-HAZARDOUS SLUDGES AND SEPTAGE) AND ANIMAL WASTES, LAND TREATMENT SHOULD BE PRACTICED TO THE MAXIMUM EXTENT TO MAKE USE OF THE NUTRIENT CONTENT OF THE MATERIALS WHILE REDUCING IMPACTS ON LANDFILL SPACE AND THE ENVIRONMENT.

## THE KEY WASTE MANAGEMENT ISSUES

In order to successfully implement the overall waste management strategy, a number of key issues must be addressed. The resolution of these issues will be difficult as each has its own set of economic, political and regulatory costs.

### Source Reduction of Wastes

The traditional approach to dealing with wastes has been to control the waste after it has been generated with little emphasis placed on processes to reduce the quantity produced. Part of the problem is that federal and state policy has not directly promoted waste reduction as a practical method of environmental protection (although it can be argued that higher disposal costs have encouraged waste reduction to some degree.) By promoting indirect incentives only, federal and state governments presume that industries are motivated to implement waste reduction methods and that economic and technical resources are available to do so. However, waste reduction efforts have been a secondary consideration to complying with pollution control regulations. As a result, waste reduction is often viewed as a long term ideal rather than an immediate alternative to pursue.

Waste reduction is a practical approach to waste management for today and will be needed much more in the future. Waste reduction makes good economic sense since it precludes wasting raw materials and reduces the ultimate costs of controlling pollutants. Moreover, many practical waste reduction measures are often possible without significant capital investment.

While larger industries have access to technical information necessary to make process changes to reduce wastes, many smaller industries lack the research and development capabilities to make waste reduction possible. A policy to effectively promote and encourage waste reduction to the fullest extent practicable is needed. To implement that policy, the following recommendation is made.

#### RECOMMENDATION

THE STATE SHOULD COORDINATE DEVELOPMENT OF A STATE AND INDUSTRY SUPPORTED AWARENESS AND TECHNICAL ASSISTANCE PROGRAM AIMED AT REDUCING THE GENERATION OF HAZARDOUS AND NON-HAZARDOUS WASTES.

The Delaware Development Office should provide a clearinghouse function with the DNREC and other public agencies (with support from the private sector) providing the technical expertise.

## **The Safe Disposal of Small Quantity Hazardous Wastes**

Only a little over one percent of the hazardous wastes generated in the United States comes from small quantity generators including households. In Delaware, the percentage would be somewhat greater than one percent since no mining or oil field brine wastes (which comprise a substantial portion of the total wastes generated in the U. S.) are generated in Delaware. In Delaware, about 1,600 tons of hazardous wastes are generated each year by Delaware businesses in individual small quantities. These wastes include spent solvents, paints and other ignitable wastes, lead acid batteries, pesticides, photographic wastes, chemical wastes from small laboratories, etc.

Nearly every household in Delaware uses products which are hazardous and become hazardous wastes when disposed. Automobile engine additives and anti-freeze, paint and varnishes, asbestos, insecticides, photographic chemicals, chlorine bleach, drain and bath tub cleaners, lead batteries, and aerosols are among the more common household products that when improperly discarded can contaminate our soils and water, causing serious threats to human, animal and plant life. Unlike the large quantity generators of hazardous waste, little control exists over commercial small quantity generators and no control exists over household hazardous wastes (because they are not legally defined as hazardous).

The major problem associated with these wastes is the absence of a convenient, inexpensive way to dispose of them. For most small quantity hazardous waste generators the cost of meeting federal and state waste disposal requirements is prohibitively high. Moreover, licensed, commercial collectors charge high fees since their operations are designed for industrial and commercial large quantity generators.

An issue which deserves particular attention is waste motor oil. The annual quantity of waste engine crankcase oil generated in Delaware is estimated at one million gallons. Of that amount, about one-half is collected for recycling, with the remaining half either stored on premises, disposed with the household trash or indiscriminantly dumped. In a recent company sponsored household hazardous wastes collection day, Hercules, Inc. found that over half of the wastes brought to the collection point consisted of used motor oil. Used engine oil (unless mixed with some hazardous substance) is not classified as a hazardous waste by EPA, and therefore its disposal is not regulated as a hazardous waste in Delaware.

The most serious obstacle to establishing a waste oil recycling program that works is the price of petroleum. When oil prices are relatively low, as they were in 1987 compared to the early 70's, gasoline station and garage owners and the sellers of motor oil cannot make a profit or break-even collecting the oil. The result is a diminishing number of collection points for the return of waste oil.

In addition to market prices, a second problem causing the decline of used motor oil recycling is the hazard of toxic materials being mixed in with collected waste oil. For example, used antifreeze, a very toxic substance, is commonly put in waste oil containers. Gasoline stations, garages, and auto supply store owners don't want to accept liability for such toxic elixirs.

#### RECOMMENDATIONS

- RECOMMENDATION 1. DEVELOP - WITH STATE, INDUSTRY AND CITIZEN SUPPORT - A PROGRAM TO INCREASE AWARENESS REGARDING THE PROPER DISPOSAL OF COMMERCIAL/INSTITUTIONAL SMALL QUANTITY AND HOUSEHOLD HAZARDOUS WASTES.
- RECOMMENDATION 2. CONDUCT - WITH STATE, INDUSTRY AND CITIZEN SUPPORT - A PROGRAM FOR THE COLLECTION OF HOUSEHOLD AND SMALL QUANTITY HAZARDOUS WASTES (INCLUDING USED CRANKCASE OIL).
- RECOMMENDATION 3. IN THE EVENT, THE COLLECTION OF HOUSEHOLD AND SMALL QUANTITY HAZARDOUS WASTES (INCLUDING CRANKCASE OIL) PROVES TO BE INFEASIBLE, DELAWARE SOLID WASTE AUTHORITY LANDFILLS SHOULD BE CONFIGURED TO SAFELY ACCOMMODATE THESE UNCONTROLLED WASTES.

### **Increased Solid Waste Reclamation Capability**

Although public attention has largely focused on hazardous waste disposal in the last decade, solid waste disposal continues to be important. Improper disposal of solid waste can have a significant impact on public health and the environment. The more immediate impacts of improper disposal include the potential for disease and odors from decaying organic wastes. Long term impacts may include the contamination of public drinking water from leachate entering underground aquifers. The long term impacts are more serious since they can remain undetected until long after the contamination has occurred.

There is sufficient capacity at Delaware's three solid waste authority landfills for only about twenty more years. This situation is of particular concern in Kent and Sussex Counties where central reclamation facilities are not available.

Despite the current twenty year capacity of Delaware's landfills, it is likely that the landfilling of waste will become a much less viable disposal option in the future. The development of a downstate reclamation facility by the late 1990's would extend the life of existing landfills in Kent and Sussex Counties and would reduce the state's dependence on landfilling as the only downstate solid waste disposal option.

#### RECOMMENDATIONS

- RECOMMENDATION 1. DEVELOP A SECOND RECLAMATION FACILITY TO HANDLE THE SOLID WASTE GENERATED IN KENT AND SUSSEX COUNTIES.

This project should be managed by the Delaware Solid Waste Authority. The planning process should be initiated in the near future since a plan may take as long as five years to complete. Special efforts should be made to include



participation by industry and neighboring Maryland counties since economies of scale will play an important part in determining cost effectiveness.

RECOMMENDATION 2. RECLAIM AND REUSE EXISTING LANDFILLS TO THE MAXIMUM EXTENT PRACTICABLE.

## Siting of Hazardous Waste Disposal Facilities

The public's typical response to the siting of waste disposal facilities, particularly hazardous waste disposal facilities, has been "not in my backyard". This is unfortunate since it is the public's consumption of products from household chemicals to medicines and pharmaceutical supplies that often generates the wastes that need disposal. The public must accept waste disposal facilities in or near their communities provided the facilities can be operated cleanly, safely, and don't cause a blight on the landscape. The only way this can happen is if the public is well informed and participates in the facility siting process.

Congress has left the siting problem in the hands of state and local government. Although there is no national law which directly addresses the siting issue, the Superfund Amendments and Reauthorization Act of 1986 mandates that within three years each state must establish a waste disposal capacity sufficient to handle its hazardous wastes for the next twenty years. In addition to considering in-state disposal, Delaware has the option of joining an interstate compact for possible disposal outside the state. Such an option would be similar to the arrangements now being finalized for the disposal of low level radioactive wastes.

Currently 34% of the hazardous waste<sup>3</sup> generated in Delaware is disposed of in-state, either through incineration or land disposal. The remaining 66% is transported out-of-state for disposal. Figure 21 shows this relationship.

Delaware has 15 treatment, storage and/or disposal facilities (TSDs) for which a RCRA permit is required. All of the operating TSD's in Delaware are permitted to handle only wastes which their company generates. All RCRA generated hazardous waste is treated or disposed on-site or shipped to out-of-state commercial TSD facilities for disposal. In addition, there are 40 large quantity generators (those businesses which generate at least one ton of waste per month), and 200 small quantity generators (those businesses which generate between 220 pounds and one ton of hazardous waste per month) located in the state.

Delaware, under the auspices of the Delaware Solid Waste Authority, can site non-hazardous waste management facilities. There is, however, no comparable authority for siting hazardous waste facilities.

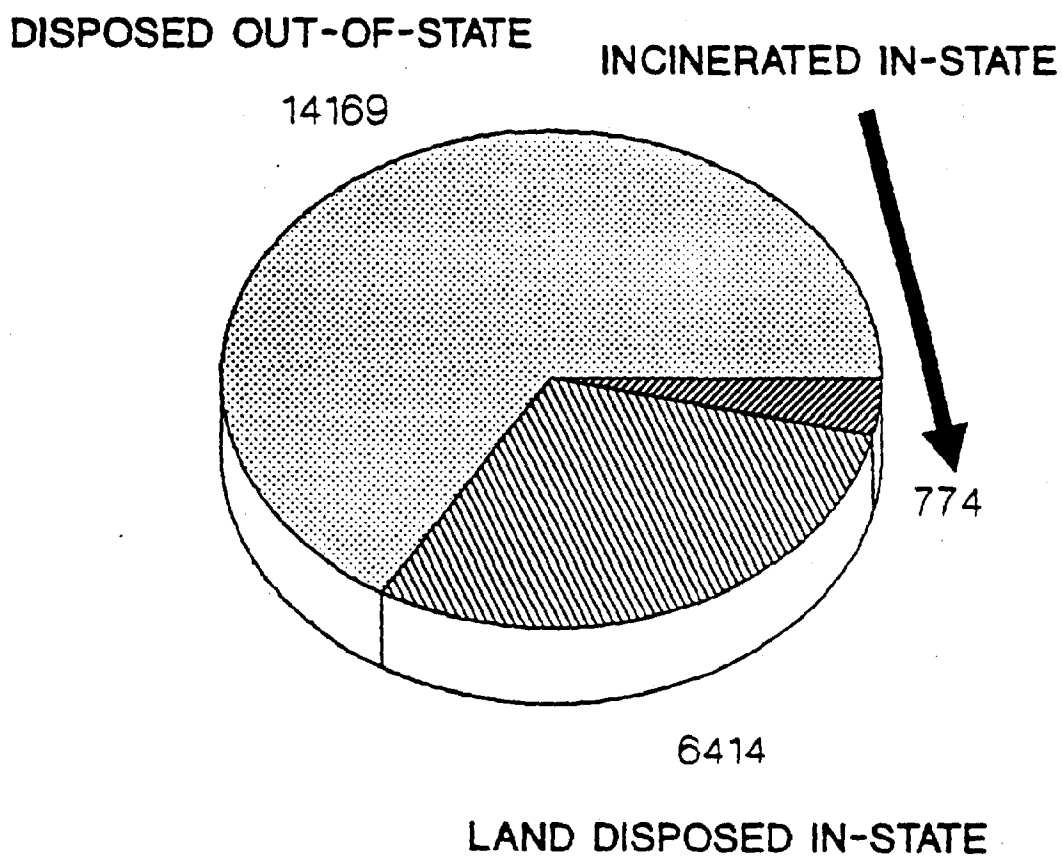
The Department of Natural Resources and Environmental Control has legal authority to regulate the siting, design, construction and operation of hazardous waste disposal facilities. Facility siting criteria have been prepared by the department but regulations are needed to make this authority effective.

<sup>3</sup>Hazardous waste as defined under the Resource, Conservation and Recovery (RCRA) Act.

Figure 21

# TOTAL RCRA HAZARDOUS WASTE GENERATED IN 1986

21,357 TONS



(DATA FROM 1986 ANNUAL REPORTS)

Source: Department of Natural Resources and Environmental Control

A new law, or amendment of the law establishing the Delaware Solid Waste Authority, is needed to plan, site, construct and operate hazardous waste disposal facilities.

#### RECOMMENDATIONS

- RECOMMENDATION 1. DEVELOP AND INTRODUCE LEGISLATION FOR A HAZARDOUS WASTE FACILITY SITING LAW. A siting law is needed to create an authority to propose a number of candidate sites, and to select a final site(s) for development.
- RECOMMENDATION 2. DETERMINE THE FEASIBILITY OF OUT-OF-STATE DISPOSAL BY MEANS OF INTERSTATE/REGIONAL COMPACTS. This option should be looked at as a substitute or supplementary to any state facility(s).
- RECOMMENDATION 3. THE PUBLIC MUST BE INVOLVED IN THE HAZARDOUS WASTE FACILITY SITING PROCESS TO THE WIDEST EXTENT PRACTICABLE. The public must be adequately informed to most effectively participate in siting decisions.

### **Funding of Hazardous Waste Site Cleanup Efforts**

For two and one-half decades hundreds of tons of toxic wastes were dumped into an unfinished canal built by William T. Love in Niagara Falls, New York. In the mid 1970's residents of the Love Canal area expressed concern over possible health effects from hazardous substances seeping into basements of homes built on landfills. As a result of Love Canal (and many other examples) the public demanded remedial action. Government officials realized their authority was limited since existing environmental laws did not provide for such response. Consequently, new legislation was introduced and in December, 1981 the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), commonly called Superfund, was enacted.

The multi-billion dollar "Superfund" is raised from general revenues and from taxes on petroleum and chemical feedstocks. The fund provides monies for immediate and long-term cleanup of sites when responsible parties cannot be found or when litigation against responsible parties may delay cleanup. To replenish the fund, CERCLA allows the government to recover cleanup costs and certain damages.

Although Superfund can be quickly tapped for emergency cleanup, states must contribute 10 percent of the costs of permanent cleanup actions at privately owned sites and 50 percent of the costs at publicly owned sites. In both instances, the cleanup costs to the state can be very significant. Unlike several states, Delaware has no state superfund to supplement federal expenditures for site cleanup. Up to now, Delaware has relied on year-to-year general and capital fund appropriations. Such a funding strategy, however, is unpredictable and makes it difficult to prepare long-term cleanup plans.

Delaware needs its own superfund program to investigate/evaluate sites before they are nominated to the National Priority List (to make sure they belong there) and to handle the bulk of sites which are (or could be) problems, but don't belong on the National Priority List.

It is estimated that Delaware may need about seventeen million dollars over the next five years to supplement federal funds for cleanup of the state's National Priority List hazardous waste sites (see Figure 22). This estimate, however, is likely to be conservative since it assumes that responsible parties will cleanup most of the sites. Additional requirements imposed by Congress may dissuade responsible parties from contributing funds "up front" and allow them to wait until cleanup is completed to begin cost recovery negotiations.

In addition to cleanup costs for superfund sites, there are a number of other waste management efforts requiring long-term sources of funding. For example, a program for collection and disposal of small quantity and household hazardous wastes may need several million dollars per year.

#### RECOMMENDATIONS

- RECOMMENDATION 1. ESTABLISH A FUND FOR THE CLEANUP OF DELAWARE'S HAZARDOUS WASTE SITES AND OTHER HAZARDOUS MATERIALS RELEASES. Delaware should investigate strategies which have been developed by other states (such as New Jersey which has established a trust fund) to determine the most appropriate mechanism to meet its long-term needs.
- RECOMMENDATION 2. DEVELOP LEGISLATION WHICH WOULD CLARIFY THE LEGAL AUTHORITY TO SUE RESPONSIBLE PARTIES TO RECOVER STATE FUNDS EXPENDED FOR THE CLEANUP OF HAZARDOUS WASTE SITES AND OTHER HAZARDOUS SUBSTANCE RELEASES.

### **Wastewater Treatment and Disposal**

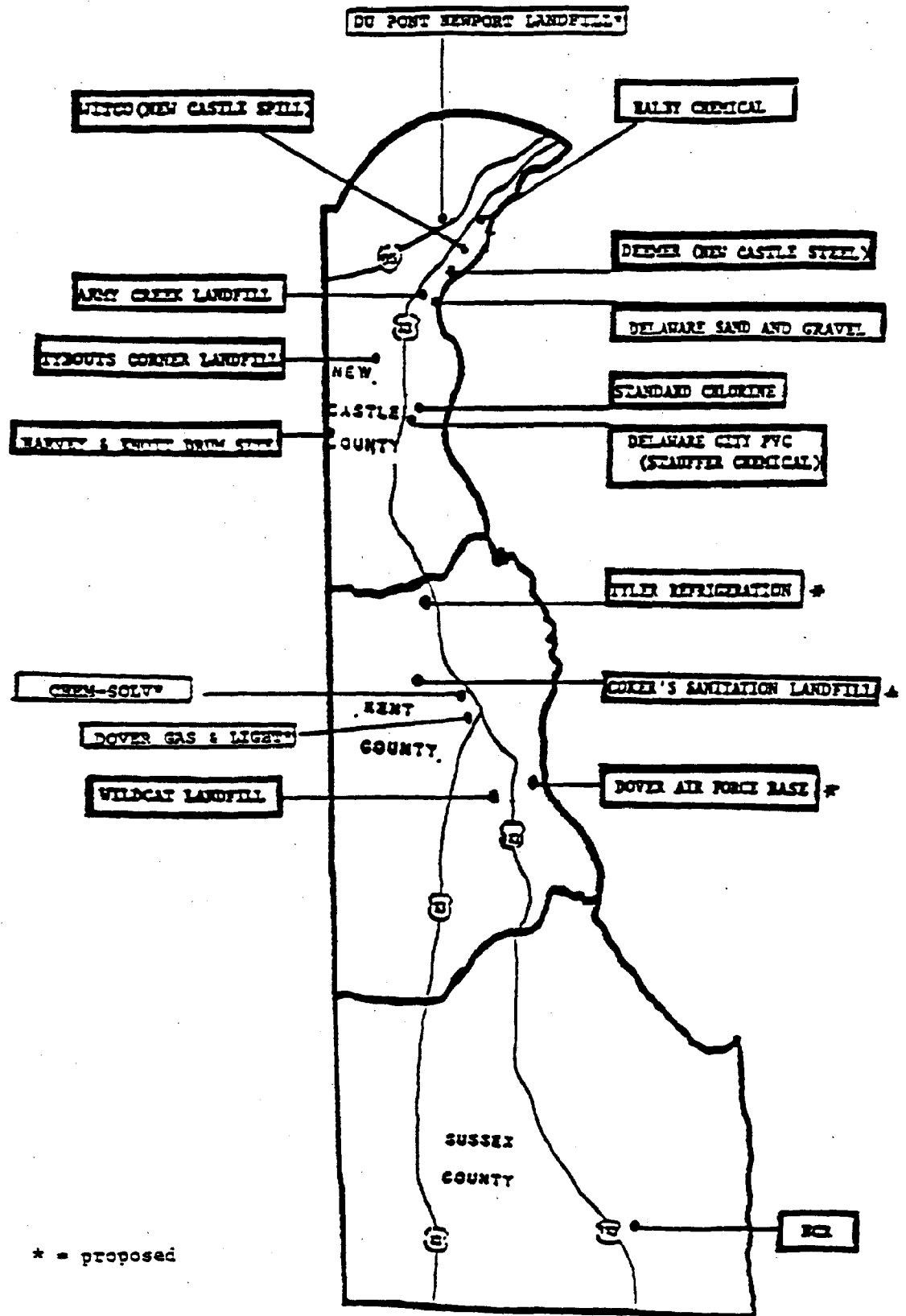
In 1972, about 70% of oxygen demanding pollutants generated in Delaware were discharged in wastewaters. Although the quantity of oxygen demanding pollutants increased 20% by 1984, only 18% was discharged. Figure 23 shows this comparison. The rest was removed by wastewater treatment processes. Similarly, total suspended solids in the wastewater flow has been reduced by 96% from 1972 to 1985. Despite those dramatic reductions, industrial pollutants that reduce oxygen levels and toxic pollutants, discharged directly from industrial discharges or through municipal treatment and disposal facilities, are a continuing concern.

During the past several years, industries have made significant investments to reduce the potency of their wastes. One key measure of industries' cleanup efforts is the increased level of compliance with state-established discharge allowances. While in 1972, few if any major industries in Delaware would have met today's permit allowances, virtually all are now in compliance with current permit conditions.

Problems remain, particularly in regard to the land application of sewage sludge, septage and treated wastewater. Land application of sludge, septage and wastewater has been practiced in Delaware for many years. In an era of increasing environmental awareness, Delaware residents have expressed legitimate concerns over what is perceived as a lack of knowledge about long-term effects of these practices. A particular concern has been the potential health risks associated with pathogens and heavy metals which may be present in these wastes. In addition, there is concern about groundwater contamination and possible contamination of crops from septage and wastewater applied to the land.

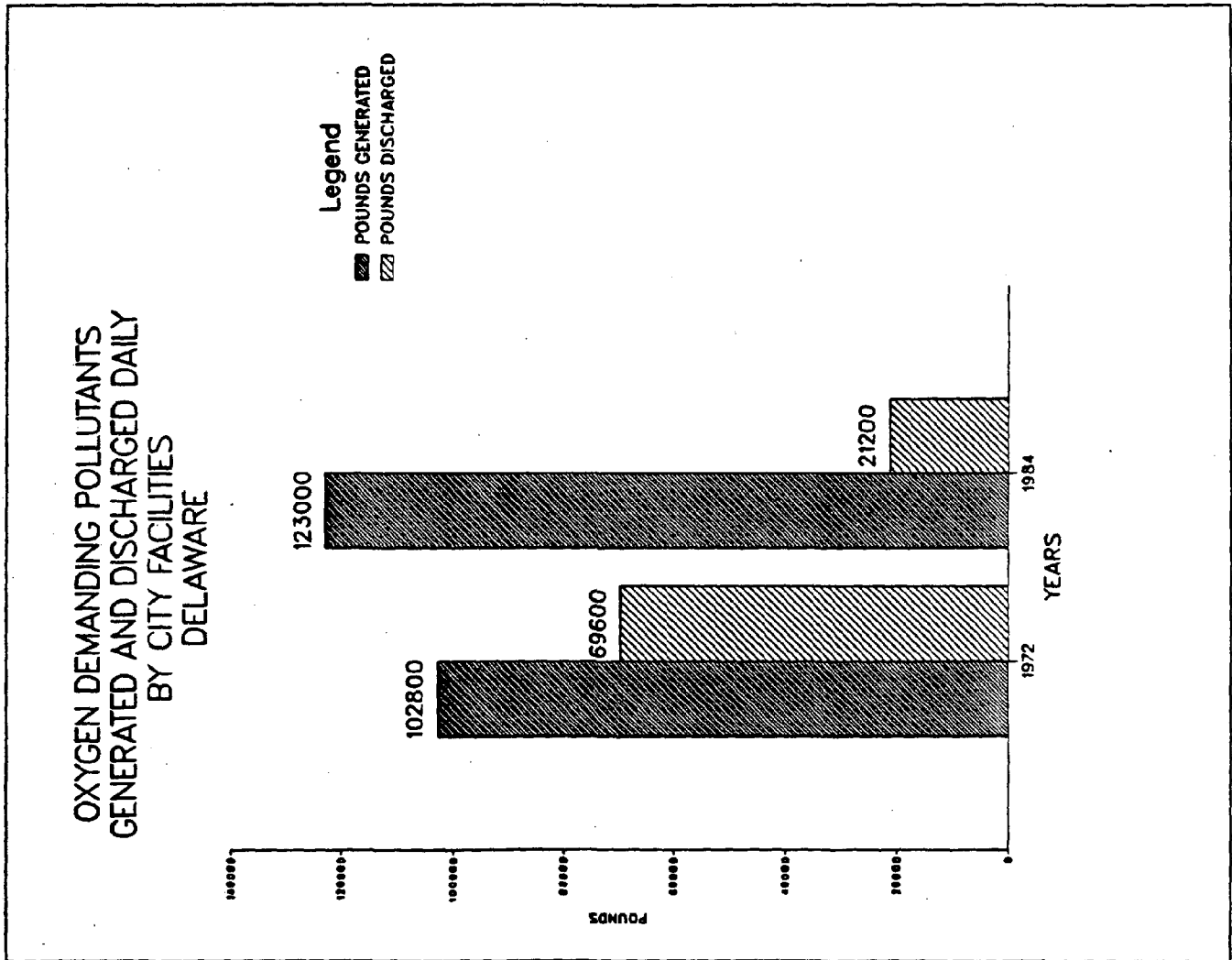
Figure 22

# DELAWARE'S SUPERFUND SITES



Source: Department of Natural Resources and Environmental Control

Figure 23



Source: Delaware's Clean Water, 1984

To avoid the uncontrolled land application of wastes and the uncertainties represented by this practice, the DNREC has prepared regulations and a document which addresses a number of technical and health related factors.

## **Use of Soils for Waste Treatment and Recycling**

The attainment of water quality goals in the face of economic uncertainties, reduced government subsidies, and rising construction costs imposes a heavy responsibility on public officials, industrial personnel, and consulting engineers. It is not enough to provide facilities that will meet effluent and water quality standards; a rigorous search for least-cost solutions to water quality problems is also needed.

Land treatment of partially treated wastewaters, sludges and other residual wastes is a proven and cost-effective alternative to traditional technology over a wide range of circumstances where the necessary land is available at reasonable cost. For effluents and sludges, it is particularly attractive at locations where the design flow of receiving waters is low, waste treatment requirements are high and suitability of landfills is low. The full advantages of land treatment will not be realized, however, unless there is a concerted effort to focus the designs on essential features. Groundwater quality and public health must be protected, but treatment hardware and operational criteria should be based on firm evidence of need. Lined earthen lagoons should be used whenever possible and concrete, steel, and firm-set structures limited except where fully justified.

Specific objectives in using land treatment technology are:

1. To apply wastes to the plant-soil system at such rates or over such limited time periods that no land is irreversibly removed from some other potential uses such as agriculture, development, forestry, etc.
2. To mix or disperse wastes into the upper zone of the plant-soil system with the objective of microbial stabilization, immobilization, selective dispersion, or crop recovery leading to an environmentally acceptable assimilation of the waste.
3. To promote effective regulation, public understanding, and implementation of current and evolving land treatment technologies by governmental units and industries in the state.
4. To establish reasonable measures of protection for the environment and public health, safety, and welfare through proper design, operation, and management of land treatment systems; and the proper treatment, transport, handling, and beneficial use of wastes.
5. To dispose of non-hazardous sludges in landfills as an inefficient use of resources. Pretreatment programs and sludge management programs should be directed to provide adequate treatment for land application.

RECOMMENDATION: GIVEN LATEST TECHNOLOGY, LAND TREATMENT OF WASTEWATER AND WASTEWATER RESIDUALS SHOULD BE ACCEPTED AS AN ENVIRONMENTALLY AND COST EFFECTIVE MEANS OF DISPOSAL IN THE FUTURE PROVIDED PUBLIC HEALTH STANDARDS ARE MET.

DNREC should proceed to adopt guidance and regulations for land treatment of wastes which would contain standards and guidelines for the best available technical and administrative approaches and which will ensure public health and environmental quality.

Public education efforts including interpretation of the guidance and rules should be made so that waste generators and those receiving the wastes on their lands will be fully knowledgeable of all factors related to this form of waste disposal.

### Wastewater Treatment and Disposal Facility Financing

For the past several years, Delaware local governments and state agencies have been able to finance the planning, design and construction of wastewater facilities through a liberal federal grant-in-aid program administered by the EPA.

Since 1972, over \$300 million has been spent in Delaware on the construction of publicly owned wastewater collection, treatment and disposal facilities. For most of this time the federal share of costs has been 75% with the state picking up 10% and local governments the remaining 15%. Some variations of this sharing ratio have occurred over the years, and with the advent of fiscal federalism, the federal share has decreased. But, clearly, the federal government has contributed the largest portion. That arrangement, however, is about to end. The construction grants program (Title II of the Clean Water Act) is phasing out and will soon be replaced by a program designed only to capitalize state revolving loan programs.

Delaware has utilized the federal program to achieve some outstanding results. Unlike most large states, which have scores of communities competing for limited funds, funds available to Delaware have been sufficient to enable virtually all communities to participate. Consequently, significant strides have been made. For example, by 1990 every Delaware municipality with a population over 500 will have built, rebuilt or upgraded and expanded its wastewater treatment facility to a minimum of secondary treatment. (Secondary treatment of sewage is generally deemed adequate to protect water quality and water uses.) There will not be a single primary treatment plant left in Delaware.

The projects built and funded in Delaware have been as diverse as the sludge handling module of the Delaware Reclamation Plant at Pigeon Point, south of Wilmington to a pump station and trunk sewer to carry the Lord Baltimore School's wastewater to Sussex County's South Coastal Treatment Plant. The projects have ranged in size from the 90 million gallon per day tertiary treatment facility in Wilmington to the 45 thousand gallon per day plant serving Port Penn's 400 inhabitants.



Because the majority of systems in the state are less than 15 years old and the average life expectancy of a system is at least 25 years, system replacement should not be necessary within the next 10 years or so. However, since the capability of local governments to fully finance major renovation, expansion and/or replacement is minimal, those costs will most likely fall on the state unless alternative funding for such projects is available. Although EPA regulations require municipalities that accept federal monies to charge sufficient rates for repair and maintenance of wastewater systems, no requirements exists for future replacement or expansion costs.

According to a 1985 EPA estimate, Delaware will require an additional \$123 million for the construction of wastewater treatment facilities by the year 2005. This estimate does not include the cost of collection systems which EPA has not estimated.

Wastewater treatment facilities have and will continue to be funded at a reduced level by the federal government through its construction grant program until 1990 when the program will be phased out. Under the existing program the federal government (EPA) provides a 55% match, the state provides 25% of the funding through annual allocations in the state capital budget and local governments provide the remaining 20%.

In reaction to the changes in the national program, many states have established revolving loan programs to provide low interest loans. Features of these programs in other states include: interest or no interest loans; capitalization techniques such as general obligation bonds, dedicated taxes, special authority bonds, annual state appropriations and mineral royalties.

Many Delaware communities, though eligible for future federal funds, will most likely be unable to repay loans obtained through a state revolving fund. Several communities that borrowed money to pay for only 10% of wastewater treatment facility costs are struggling to repay those loans. Even a state program that only requires communities to repay principal and little or no interest will exclude participation by some. Many will need outright grants from the state to build sewage facilities. The state's larger municipalities and the three counties can raise needed capital by issuing bonds on their own. Consequently, participation by Delaware in EPA's revolving loan program does not appear practical at this time. However, a final decision in this regard will be made upon completion of the water supply and wastewater feasibility study described earlier in the Managing Delaware's Water Resources section of this report. For some of the state's smaller communities, participation in EPA's Small Community Outreach Program may be suitable.

### Small Community Outreach

EPA has made small community outreach — targeted at those communities which cannot afford to pursue conventional approaches to central wastewater treatment plant design and construction — a priority item for the states and has issued guidance for development of state outreach programs.

An outreach program would be comprised of several elements. First, the state would assess outreach needs, including communities likely to participate, environmental impacts caused by the lack of efficient facilities, and the economic status of community residents. Needs would be prioritized, and the ability of the State to satisfy needs with existing programs would be considered. Several Delaware towns, such as Hartly, Kenton, Little Creek, Leipsic, and the Delaware Bay-side beach communities, are potential candidates

for this service. In cases where outreach is needed, community-specific plans would be developed. Plans would detail assistance techniques for project management, technology selection, grant management, financing, and operation and maintenance. Innovative programs such as the New York "Self-Help" Support System would be utilized. Self-Help allows communities to accrue large savings through techniques such as volunteer or local public works labor, borrowing equipment, hiring part time engineers shopping around for best prices on parts and labor, and the use of low-cost technologies.

Outreach also requires significant input by the state through technical assistance and information transfer, in effect providing the community with cost-free and useful advice by performing many of the services for which consulting engineers would otherwise be necessary.

#### RECOMMENDATIONS

- RECOMMENDATION 1. IN LIGHT OF THE PHASE OUT OF THE FEDERAL WASTEWATER FACILITIES CONSTRUCTION GRANTS PROGRAM, A POLICY TO FINANCE WASTEWATER SYSTEMS MUST BE ESTABLISHED BY THE STATE. Without such a program local requests will be evaluated on a first come first serve basis resulting in political battles through the capital budget process.
- RECOMMENDATION 2. A COMMUNITY OUTREACH PROGRAM SHOULD BE ESTABLISHED IN DELAWARE TO PROVIDE WASTEWATER TREATMENT AND DISPOSAL CAPABILITIES TO QUALIFIED SMALL COMMUNITIES. The program would be set-up for general application to qualified communities with specific plans developed on an individual basis.

Implementation of Recommendations 1 and 2 should await completion of the feasibility study described earlier.

### **Manure Waste Management**

Perhaps the most important agricultural waste, (due to its sheer volume and potential to seriously pollute groundwater) in Delaware is poultry manure. The volume of poultry manure produced in Delaware has increased from 180,000 tons in 1970 to 280,000 tons in 1986, a 56% increase. This trend is expected to continue through at least 1991 averaging about a three percent increase each year. Recent data has shown an accompanying decrease in the amount of commercial fertilizers purchased in Delaware during the last few years.

Throughout most of the 1970's poultry manure was considered a waste and was disposed of accordingly. However, efforts by the University of Delaware's Agricultural Extension Services have resulted in a dramatic change in the way poultry manure is used today. It is now looked upon by farmers as a profitable resource that can be substituted for the higher costs of commercial fertilizers. Voluntary nutrient management programs have met with modest success. The primary environmental and health concern in manure management is to ensure that the manure applied to farmlands can be taken up by the crops and not percolate through the soils and contaminate groundwater.

Particular attention must also be paid to the storage and handling of poultry manure prior to cropland spreading and the use or disposal of excess manure that cannot be applied.

Recommendations concerning manure waste management can be found in the Agricultural Lands and the Environment section of this report.

## Special Waste Issues

### Ocean Dumping/Incineration

There are four principal kinds of wastes disposed of or proposed to be disposed of in the ocean off Delaware's coast that are of concern to the state:

1. Treated sewage sludge from New York City and northern New Jersey municipalities dumped at the federally designated 106 mile site about 138 miles east of the Delaware coast beyond the edge of the continental shelf;
2. Industrial acid and alkaline wastes dumped in a designated area within the 106 mile site; and
3. Liquid hazardous wastes such as DDT, PCB, and dioxin which are incinerated in specially designed vessels at designated incineration sites. One such proposed site is immediately south of the 106 mile site off the Delmarva coast beyond the continental shelf edge. No incineration has yet been permitted off the U. S. Atlantic coast; and
4. Plastic wastes dumped at sea which not only foul our beaches but kill marine life through entanglement or ingestion.

The Environmental Protection Agency under authority of the Marine, Protection Research and Sanctuaries Act and its ocean dumping provisions is the permitting authority for ocean dumping including incineration. The Coast Guard regulates barge and vessel navigation from the loading port to the dumping/incineration site and regulates vessel loading of hazardous wastes. Disposal activities at the ocean site come under EPA authority. Other federal agencies are involved with research concerning the effects of dumping and incineration on the marine environment, marine ecology, and public health.

The principal environmental issues of concern regarding ocean waste disposal are:

- a. Illegal short dumping of sludge or industrial wastes and accidental dumping of liquified hazardous wastes within or near state coastal waters;
- b. Possible contamination of coastal waters and beaches from sludge dumping, hazardous waste spills, plastic, infectious and other wastes;
- c. Long term damage to the marine environment and harm to marine life from ocean dumping, incineration and plastics pollution;
- d. Adequacy of the federal regulatory system including a number of federal agencies, laws and regulations to police the disposal operations in a thorough, coordinated way; adequacy includes capability in terms of money, manpower and equipment;

- e. Adequacy of provisions for damage liability in cases of accidental (or deliberate) releases of waste material and resulting public and private damages.

Current Delaware policies on ocean waste disposal are as follows:

- a. Dumping and incineration of wastes in the ocean must be considered within an overall, comprehensive national waste management program including waste at-source reduction and waste recycling as well as on-land disposal.
- b. Permits for ocean incineration and dumping must be based upon the least environmentally harmful option and must never be based upon political acceptability or what is most convenient or least expensive for the permit applicant.
- c. Strict and comprehensive EPA regulations must be in-place prior to issuance of any permit.
- d. Use of the ocean for waste disposal must be viewed as an interim, short term measure to be used only until better waste management alternatives are available, consistent with the intent of the Congress in the Marine Protection Research and Sanctuaries Act to avoid making the ocean a permanent repository for man's wastes.
- e. Federal authorities must ensure that the proposed ocean waste disposal activity is fully consistent with each affected coastal state's coastal management program as provided under terms of the federal Coastal Zone Management Act of 1972.

#### RECOMMENDATIONS

- RECOMMENDATION 1. THE STATE SHOULD SUPPORT LAND BASED DISPOSAL OF WASTES OVER OCEAN DUMPING/INCINERATION.
- RECOMMENDATION 2. THE USE OF THE DELAWARE RIVER AND BAY AS A TRANSPORTATION ARTERY FOR OCEAN BOUND HAZARDOUS WASTES INCINERATION VESSELS SHOULD NOT BE ALLOWED.
- RECOMMENDATION 3. THE STATE SHOULD SUPPORT FEDERAL LEGISLATION ON PLASTIC'S POLLUTION RESEARCH AND CONTROL.

### **Transportation of Hazardous Wastes**

The transportation of hazardous waste and hazardous materials is recognized as an issue because of the potential health and environmental effects resulting from a transportation-related accident or emergency. This is a particularly relevant concern in light of the volume of hazardous waste and materials that are moved by rail and highway.

Improvements in technology have significantly reduced a transportation vehicle's vulnerability to accidents. Railroad tank car design and construction improvements have reduced the number of major environmental/public health emergencies associated with train derailments.

The transportation of hazardous materials is regulated by the United States Department of Transportation. The Delaware Department of Transportation and the Delaware Department of Public Safety help enforce numerous aspects of the federal law by conducting truck inspections at selected sites in Delaware.

The transportation of hazardous wastes is also regulated by the United States Environmental Protection Agency under the provisions of the Resource Conservation and Recovery Act amendments of 1980. Delaware also has the authority to regulate the transportation of hazardous waste under state law (7 Del. Code C. 63).

Existing regulations appear to be sound but implementation of the regulations, particularly those governing the transport of hazardous materials, appear to be weak. Regulations do not exist to control the routing of hazardous materials/waste transporters through the state.

The establishment of safe transportation corridors for hazardous materials/waste shipments while desirable from the public's viewpoint might be legally impossible due to Interstate Commerce Act provisions which allow for the uninterrupted movement of cargoes throughout the United States.

There may be resistance by the trucking and railroad industry to increased regulation over the transportation of hazardous materials. Moreover, the establishment of safe transportation corridors within Delaware could be challenged in the courts as interfering with the free commerce provisions of the Interstate Commerce Act.

Delaware has no clearly defined policy which deals with the safe transportation of hazardous materials/hazardous wastes, although preliminary recommendations were developed by the Hazardous Materials Commission in early 1984. The emphasis appears to be placed on responding to a transportation related emergency as opposed to preventing the emergency from occurring.

#### RECOMMENDATION

THE STATE SHOULD ESTABLISH A POLICY GOVERNING THE TRANSPORTATION OF HAZARDOUS WASTES AND HAZARDOUS MATERIALS TO MINIMIZE POTENTIAL ADVERSE IMPACTS TO THE PUBLIC HEALTH AND THE ENVIRONMENT.

Steps to implement this recommendation include:

1. Determine the effectiveness of DOT, EPA and state (DPS-DNREC) policies/procedures/requirements concerning the transportation of hazardous wastes/materials in Delaware.
2. Examine the feasibility of establishing transportation corridors for hazardous wastes/materials shipments.
3. Strengthen inspection program for vehicles transporting hazardous wastes and materials.

# PROTECTING OUR FRAGILE ECO-SYSTEM

## INTRODUCTION

Although 10,000 years ago hunting for food, clothing materials and shelter was the major human caused impact on the environment, the greatest threat to our life support systems and ecological processes today is habitat modification. Indeed, the bulldozer is a far more effective agent of extinction than the cudgel, bow and arrow or the gun ever was. Every house, road, shopping center, farm field, commercial building and parking lot is built on land once occupied by natural communities of organisms. Construction along coastlines and lake shores, on barrier islands and in river valleys can be particularly dangerous to ecologically fragile communities. Certain agricultural and forestry practices, especially in environmentally sensitive areas, can also be damaging.

In some coastal areas, tidal marsh, which provides nursery grounds for fishes and exports food to adjacent coastal waters, is being destroyed by housing development, marinas and other forms of man's intrusion. Often man unwittingly destroys the very amenities he seeks.

Socrates has said that he was only wise enough to know how much he did not know. Contemporary man should be wise enough to admit the enormity of what is not yet known. The discovery of the utilitarian values of the vast majority of species, for example, will lie in the future, if we allow them a future.

## THE KEY ISSUES

### Wetlands Protection

#### Wetland Values and Trends

Wetlands provide habitat for fish, shellfish, waterfowl, other birds, aquatic furbearers, reptiles and amphibians; preserves for rare and endangered plants; water quality enhancement through pollution filtration, sediment removal, oxygen production, nutrient recycling, chemical and nutrient absorption; microclimate regulation; flood control; erosion control; groundwater recharge; water supply; areas for fishing, hunting and trapping, and aesthetic and recreational values.

#### Tidal Wetlands

Between 1938 and 1973, about nine percent of Delaware's tidal wetlands were lost (8,252 acres out of 91,672 total acres) mostly from filling to build houses, industrial sites or roadways. Between 1954 and 1971, the annual loss of tidal wetlands averaged 444 acres per year. From 1973 to 1979 with the help of the Coastal Zone Act (1971) and the Wetlands Act (1973), the annual average loss of tidal wetlands through human destruction dropped from 444 acres to 20 acres per year. Under current regulatory programs, and with a modest expansion of enforcement capabilities, it appears that Delaware's tidal wetlands can be largely protected in the future from human-caused degradation or loss. However, man's development in adjacent upland areas and ongoing natural changes may mean additional losses.

Global sea level rise and local land subsidence will probably have a significant effect on the location and extent of tidal wetlands in the not too distant future. As land along our shorelines becomes more scarce, there is a tendency to build closer and closer to tidal wetlands. Because of sea-level rise and local land subsidence, the natural growth of tidal wetlands will be landward and the increased rate of sea level rise expected in the future will hasten that landward movement. Intensive development next to wetlands will most likely lead to wetland loss as the seaward sections of marsh are inundated and eroded while the landward portions are not permitted to grow. Buffer zones (areas in natural vegetation where development is restricted) situated landward of the marsh-upland edge are effective means to permit future landward expansion and should be promoted.

## Freshwater Wetlands

Freshwater wetlands perform a valuable function in maintaining our essential ecological processes and need more protection than is currently afforded. Even though most people equate tidal marshes with wetlands, freshwater (non-tidal) wetlands are more abundant, currently covering about 148,000 acres and comprising 64% of the state's total wetlands. Forested wetland is the most widespread type representing 90% of the state's freshwater wetlands.

The loss of freshwater wetlands in Delaware has been much more dramatic than the loss of tidal wetlands but has not received as much attention. The U. S. Fish and Wildlife Service estimates that from 40-50% of Delaware's freshwater wetlands have been lost since colonial days. Although the federal government through the U.S. Army Corps of Engineers, regulates development on freshwater wetlands, the state does not have regulatory powers over this important natural resource as it does over tidal wetlands.

The best available data concerning freshwater wetland loss shows a 21% loss from 1956 to 1979 or about a 38,000 acre decline. Losses due to drainage (directly and indirectly) account for 82% of the loss, losses from urban development make up 12%, while the remaining six percent has been converted to open space.

Similar to the tidal wetland question that was debated in the early 1970's, nobody knows with certainty how much freshwater wetland acreage is "needed" to maintain a watershed's ecological structure and function. What can be stated however, is that there is a correlation between freshwater wetland acreage and the abundance and quality of the watershed's natural resources. The amount of freshwater wetlands that is needed can also be rephrased as "how much more can be lost without dramatic degradation?" Unfortunately, the answer to that question is usually reached only after a downward threshold limit has been passed, with irreversible cumulative losses and permanent damage.

Considering Delaware's historic freshwater wetlands loss, a number of questions beg for answers: how close are we today to that downward threshold, or have we already exceeded it? Would many of the water quality problems that exist today occur if we had better wetland management and practiced sound land-use management 50-years ago? If we had waited to "know how much tidal wetlands were needed," what would have happened to our tidal wetlands and estuaries between 1972 and today? Since we have already lost a substantial portion of Delaware's freshwater wetlands, doesn't it seem prudent to better manage those remaining? Where will we be 50-years from now?

The "swampbuster" provision of the 1985 Food Security Act (the 1985 Farm Bill) is a new federal conservation initiative to protect freshwater wetlands by creating economic disincentives (e.g. loss of crop subsidies, loss of low interest loans) to discourage conversion of existing wetlands to cropland by drainage. Swampbuster provisions, however, will only apply to wetland drainage projects that commenced after December 23, 1985, and may not apply if it is determined that new drainage projects "will have minimal effect on wetland values." "Swampbuster" is an effective wetlands protection tool, but was never intended to be the complete "answer" to limiting wetlands conversion.

Wetland mitigation proposals (which are intended to compensate for lost ecological values and functions of altered wetlands) should not become a substitute for outright denial of controversial development projects that would unjustifiably degrade or destroy wetlands. Mitigation does have a role in a freshwater wetlands conservation program, but it should only be used when adverse effects on existing wetlands are unavoidable. A development project that might permanently alter wetlands should first be considered for redesign in order to avoid such lasting effects; if redesign is not possible, then whether the project should be done at all should be considered; if such a project cannot be redesigned nor abandoned, then mitigation should be considered.

When the need for mitigation is unavoidable, mitigation should re-create wetland habitats of the same type and size of those lost, require scientifically credible restoration plans and monitoring, and have enough flexibility to allow for modification to achieve management objectives.

Since wetlands in their natural state have significant values for wildlife and for society that may be very difficult to simulate or re-create, mitigation projects may take a very long time (e.g. a century) to achieve those benefits, if they achieve them at all. Conversely, some mitigation projects, when properly designed, sited, and managed could yield positive attributes to a watershed's wetlands. The broad public interest is served when wetland values are protected, and the public should be protected from inheriting the economic liabilities associated with lost wetland functions.

Scientific knowledge about the environmental values and functions of specific wetland types will lag behind the need to make land use decisions. Accordingly, it would be prudent to adopt guidelines for land use and management which stress freshwater wetlands protection. A state freshwater wetlands management program would benefit Delaware landowners who could work with DNREC, in conjunction with the federal government to resolve problems.

#### RECOMMENDATIONS

##### RECOMMENDATION 1. DEVELOP AND IMPLEMENT A COMPREHENSIVE, STATEWIDE FRESHWATER WETLANDS CONSERVATION AND MANAGEMENT PROGRAM.

This program should combine regulatory and non-regulatory means and should include the necessary legislation, regulations, guidelines and administrative mechanisms to provide for:

- a. A freshwater wetland classification system to be recognized and used by all parties.
- b. Identification and mapping of freshwater wetlands



- c. Identification of those wetland areas where conversion or development should not be permitted, supported by the necessary legislative authority.
- d. Identification of those management practices which are compatible with wetlands' ecological values and functions/and as such would be permitted to be done in wetland areas.
- e. Development of an effective wetlands mitigation program with adequate safeguards to prohibit unjustifiable wetland conversion projects.
- f. A requirement that the burden of proof for demonstrating that the public benefits from wetland conversions outweighs the environmental effects rests with the applicant proposing the conversion project.

RECOMMENDATION 2. ESTABLISH BUFFER ZONES TO HELP PRESERVE FRESHWATER WETLANDS.

## Protection of the Delaware Estuary

### Introduction

The Delaware Estuary (Figure 24) borders three states: Delaware, New Jersey, and Pennsylvania. From Hancock, New York to the mouth of the Delaware Bay the Delaware River flows 330 miles, draining one percent of the U.S. land area. Over ten percent of the nation's population rely on the waters of the Delaware River Basin for potable and industrial water supplies.

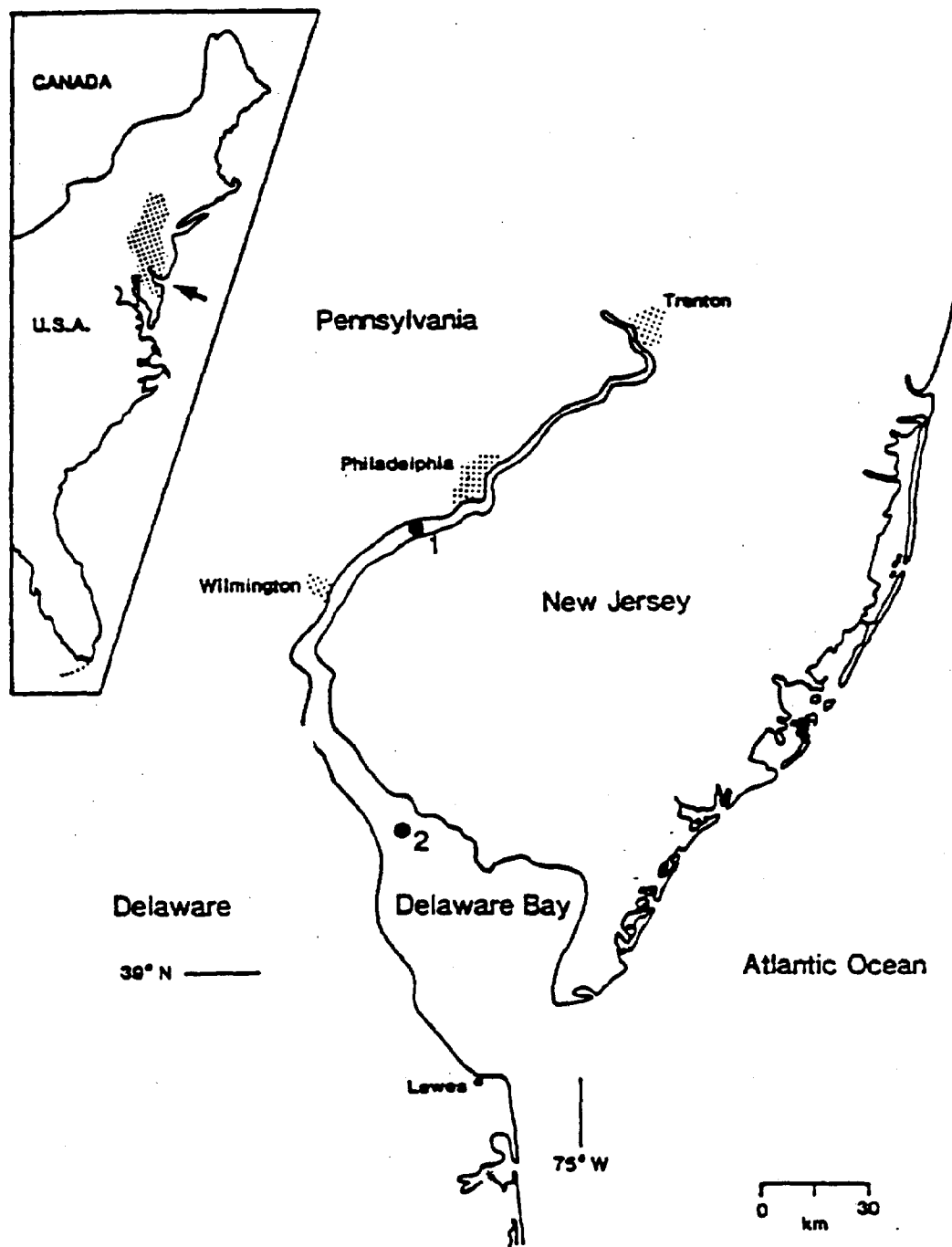
The tidal Delaware River extends from Trenton, New Jersey to Liston Point, Delaware, and flows through the nation's fifth largest urban area, the Philadelphia-Camden metropolitan area. Ports at Trenton, Philadelphia, Marcus Hook and Wilmington, make the river one of the world's largest freshwater port complexes. Historically this section of the Delaware has also been one of the nation's most severely polluted rivers.

The 782 square mile Delaware Bay is 48 miles long and from 4 to 20 miles wide. The Bay is biologically productive and the home of commercially and recreationally important fin and shellfish.

### Mans Impacts on Estuaries

Estuaries and coastal waters, in particular, have borne the brunt of marine waste disposal activities, and many now exhibit a variety of adverse effects. Unless additional protective measures are taken, many estuaries and some coastal waters will deteriorate further or begin to do so during the next few decades, even in areas that previously were improving. This deterioration is of great concern because these waters support commercial and recreational fishing, swimming and boating, and other activities generated by the tourist trade. They also provide critical habitat for numerous plants and animals, including some endangered species and many important commercial species. For example, commercial landings of fish and shellfish from U.S. marine waters had a dockside value in 1985 of \$2.3 billion and a retail value several times greater: fish and shellfish harvested within three miles of shore accounted for roughly half of these revenues.

Figure 24  
The Delaware Estuary



Almost 2,000 major industrial and municipal facilities discharge wastewater directly into estuaries and coastal waters in the United States, and thousands more discharge into rivers that eventually flow into estuaries. Scores of industries discharge wastes into the sewers of municipal treatment facilities that later discharge into estuaries. Large volumes of dredged material and smaller volumes of sewage sludge and some industrial wastes are dumped at other sites. In addition, runoff from urban and agricultural areas is a significant source of estuary pollution. Filling of wetlands and channeling of rivers also affects marine waters.

The range of adverse effects includes:

- \* Changes in water quality, such as excess levels of nutrients, low levels of dissolved oxygen, and turbidity;
- \* Loss of aquatic vegetation;
- \* Effects on fish, shellfish, birds, and mammals, such as accumulation of toxic chemicals, disease and abnormalities, reproductive failure, and mortality;
- \* Changes in entire marine communities, such as declines in population and impacts on species diversity;
- \* Closures of beaches and shellfish grounds due to contamination with microorganisms or toxic chemicals;
- \* Rising incidence of reported human disease from consuming contaminated shellfish or swimming in contaminated marine waters;
- \* Accumulation of toxic pollutants in sediments.

There is a misconception that the Delaware estuary is hopelessly polluted, leading some to suggest it be written off for recreation and considered an industrial estuary. Conversely, there is every reason to believe that water quality in the estuary is improving. Although heavy pressure from human activity has caused serious environmental degradation directly adjacent to those areas, marked improvement in water quality of the upper estuary has been documented and the lower estuary apparently possesses some fairly effective natural cleansing abilities.

State-administered regulatory and non-regulated programs have significantly reduced the quantities of pollutants entering the estuary. Under the Clean Water Act, the construction or upgrading of municipal sewage treatment plants has improved some aspects of water quality, particularly with respect to levels of oxygen and nutrients. Moreover, reducing industrial pollutant discharges into sewers has improved the quality of municipal sludge, enhancing its potential for beneficial uses such as fertilizer and compost.

What happens in the estuary is only partly within the state's control. Actions that take place in Pennsylvania or New Jersey are beyond Delaware's direct control. In addition, federal agencies such as the U.S. Army Corps of Engineers and the U.S. Coast Guard have certain jurisdictions in the estuary.

## Estuarine Water Quality

Recent studies in the Chesapeake Bay have documented relationships between the health of living resources and water quality. Desirable fish and shellfish species and rooted aquatic plants decline when plant nutrients (fertilizers) increase beyond acceptable levels. Under these stresses, desirable fish species are often replaced by other fish that have higher tolerances to the stressful conditions.

Chemical loading also may be detrimental to an aquatic ecosystem where heavy metals, pesticides and herbicides, plasticizers, and petroleum chemicals are released to the environment. These substances may be directly toxic to aquatic life when introduced into the estuarine environment in high levels. At lower levels they may cause cell and genetic damage to eggs, embryos and larvae, fin erosion, sores of the body, and latent infections which may result in disease.

A key objective of the state should be to achieve a degree of water quality that can restore anadromous fish and other indigenous fish populations sufficient to sustain recreation and commercial fisheries. A Delaware River Basin Commission sponsored use attainability study will determine what aquatic uses are being supported, what may be supported based on physical, chemical, and biological characteristics of the estuary and identify causes of use impairment. This research will provide guidance on whether it is reasonable to expect full restoration of anadromous and indigenous fish populations in historically polluted portions of the estuary.

To achieve that goal a number of actions by other states in the Delaware Valley may be needed, including land management practices that use conservation tillage and reduce soil erosion, water runoff, over-fertilization, chemical application, and deforestation. Consideration should also be given to reduce phosphorus inputs into the river either through improved wastewater treatment processes or indirectly through controlling the use of certain phosphorus containing products. In addition, the introduction of toxic substances such as chlorine, heavy metals and biocides into the estuary would have to be controlled.

## Habitat/Restoration

The Delaware estuary, including its wetlands and tidal river, has been under the geological stress of sea level rise over the past 12,000 years. Estuarine habitats, salt marshes, narrow sandy barriers, near shore tidal flats, shoals and channels have continually migrated landward.

Man has altered this natural process by dredging (with resultant turbidity), attempts to stabilize shorelines, disruption of longshore flow of sediment, destruction of shell bottom areas, entrapment of mud and sands in near shore breakwaters and groin fields, deepening of rivers, construction of marsh and fresh water swamp drainage systems, construction on the narrow barrier, development over wetlands, expansion of landward edge of marsh wetlands, and changes in marsh soil and nutrient conditions. Since marshes and beaches normally migrate landward as sea level rises, development of inland areas will prevent landward migration. Consequently, in due time accelerated sea level rise will be devastating for low lying marshes and beaches since they will eventually disappear under a rising sea.

Much of the fine sediment entering the Delaware estuary from its tributaries is deposited in its bordering marshes. This process is necessary to maintain marshes in the face of rising sea level. However, roughly three million tons of fine sediment finds its way into the navigation channels of the estuary each year and must be dredged. Dredging and disposal of spoil may be an important mechanism by which sediment-associated toxic substances are removed from the estuary. Dredging must be accomplished with care, however, so that excessive biochemical oxygen demands are not created.

Although certain portions of the river have among the highest concentrations of nutrients, noxious plankton blooms, classically associated with those concentrations, do not seem to be a problem due to the high turbidity caused by suspended sediments.

The decline of fishery resources in the Delaware estuary over the last century has been caused by a variety of factors. Increasing fishing pressure by commercial fisheries in Virginia and North Carolina on species that winter offshore in the ocean and migrate into the estuary has reduced their populations. Shoreline development has reduced the area of salt marshes and tidal mud flats used as spawning habitat and nursery areas. Residential, agricultural, and industrial development have decreased water quality and contributed to declining fisheries. Dramatic examples include the decline of striped bass due in large part to physical alteration and chemical disturbances in spawning areas of the lower Delaware River. Also, direct sedimentation effects and increased salinity have reduced oyster beds. In addition, the indirect effects on the food chain supporting the fisheries are even more complex and less well understood. Figure 14 shows the decline in anadromous fish landings during the last century (anadromous fish migrate to fresh water to spawn and return to salt water).

Effective management of fishery resources must be directed primarily toward enhancement of the physical and chemical environment of estuarine waters and the maintenance or restoration of habitat. Restoration and effective management of the estuary's resources is a cooperative federal and state process and responsibility.

Because of spawning migrations and behavior, striped bass and American shad populations would benefit most from restorations, particularly of spawning areas in the lower Delaware River. Oysters would benefit from restoration of seed bed areas, development and planting of MSX disease resistant oysters, and more river flow to decrease salinities. Finally, access to fishing areas will have to be addressed as fishery resources are restored.

### **Recreational Access**

The Delaware River and Bay holds additional potential as a site for fishing, boating, picnicking, etc. By the year 2000 and beyond, the river and bay could become a recreational outlet for Delawareans.

The Delaware beach areas: Rehoboth, Dewey, Bethany, Fenwick Island, and the inland bays are becoming overcrowded. As the state's population increases these beach areas may become less attractive. Moreover, a large portion of Delaware's population resides above the Chesapeake and Delaware Canal and many of those residents must travel over ninety miles to reach the beach. Accordingly, the river may provide a convenient alternative for recreation.

If the state would acquire lands along the Delaware River as those lands become available recreational facilities such as boat launching ramps, fishing piers, picnic grounds and lavatory facilities could be developed.

## National Estuary Program

The Water Quality Act of 1987 formally established the National Estuary Program with the goal of identifying nationally significant estuaries, protecting and improving water quality, and enhancing living resources. It also identifies eleven estuaries for priority consideration by EPA under the national program including six sites where the program is already active and, five other potential program sites: Delaware Bay in Delaware and New Jersey; Delaware Inland Bays in Delaware; New York-New Jersey Harbor in New York and New Jersey; Sarasota Bay in Florida; and Galveston Bay in Texas.

The act calls for EPA to develop a process by which local estuarine "constituents" can cooperate to develop long-term protection and management plans. The EPA provides the technical expertise and the organizational structure for working partnerships among state, local, and federal interests. But the programs to manage estuarine resources must come from the state and local governments.

### RECOMMENDATIONS

RECOMMENDATION 1. RETURN WATER QUALITY IN THE DELAWARE RIVER TO A CONDITION THAT CAN RESTORE ANADROMOUS FISH AND OTHER FISH POPULATIONS SUFFICIENT TO SUSTAIN VIABLE RECREATION AND COMMERCIAL FISHERIES.

This recommendation would be implemented in three general phases:

1. Determine water quality conditions necessary to restore fish stocks (the DRBC Use Attainability Study, may satisfy this need).
2. DRBC set water quality standards that will ensure viable fisheries in the estuary.
3. Implement point and nonpoint pollution controls and practices necessary to achieve standards.

Guidance in implementing these recommendations will be provided by the Water Resources Policy Advisory Board recommended in the Protecting Our Water Resources Section of this report.

RECOMMENDATION 2. GUIDELINES AND REGULATIONS TO PROTECT OR RE-CREATE NATURAL SHORELINES SHOULD BE DEVELOPED AND FOLLOWED.

Protection of natural shorelines and tidal wetlands must be recognized as vital to the estuary's continuing environmental health. Natural shorelines and tidal wetlands must be protected and reconstructed (with buffer zones where possible) wherever possible to provide the required spawning and nursery habitats for fish. These areas also play a significant role in improving water quality.

Movement toward an integrated marsh management approach will support the goal of protecting tidal wetlands. Necessary actions include:

- \* Decreasing spread of Phragmites; convert many existing areas covered by Phragmites to habitats dominated by plant species more valuable to wildlife.
- \* Increasing surface water on dewatered tidal marshes and wildlife ponds.
- \* Increasing active management of impounded tidal marshes to more fully realize their environmental benefits--use comprehensive water management plans to achieve multiple objectives.
- \* Decreasing saltmarsh mosquito breeding in conjunction with more reliance on biological control and less use of chemical insecticides with techniques such as "open marsh water management."
- \* Enhance and restore nursery habitat for marine fishes and shellfish.

RECOMMENDATION 3. REGIONAL PLANS FOR THE MANAGEMENT OF FISH STOCKS IN THE DELAWARE ESTUARY SHOULD BE DEVELOPED AND IMPLEMENTED.

Plans must consider all aspects of the fishery which will require interstate cooperation. It will be necessary to work closely with New Jersey, Pennsylvania, New York, Maryland, the Atlantic States Marine Fisheries Commission and the Mid-Atlantic Fisheries Management Council to develop and implement these plans.

Obstacles may include jurisdictional disputes over the estuarine waters Delaware owns to the New Jersey line. It will be the responsibility of the respective state legislatures to authorize the implementation of interstate fisheries management plans acceptable to residents of all states bordering the estuary.

RECOMMENDATION 4. THE ACQUISITION, DEVELOPMENT AND ACCESS TO LANDS ALONG THE DELAWARE RIVER SHORELINE FOR WATER RECREATION SHOULD RECEIVE A HIGH PRIORITY.

Properties should be identified and acquired by the DNREC and New Castle County. Adequate public access to the river is warranted since large sums of public funds have been expended in restoring river water quality.

RECOMMENDATION 5. FOLLOWING UP ON THE DELAWARE BAY CONFERENCE THAT TOOK PLACE IN 1986, THE STATE UNDER THE AUSPICES OF THE NATIONAL ESTUARY PROGRAM, SHOULD PROCEED TO ESTABLISH MANAGEMENT CONFERENCES UNDER THE NATIONAL ESTUARY PROGRAM FOR DELAWARE'S INLAND BAYS AND DELAWARE BAY.

The following should be addressed:

- a. Consideration and satisfaction of the requirements of the Water Quality Act of 1987 for both estuaries.
- b. Development of a proposal, reflecting multi-state participation, for Delaware Bay.
- c. Establishment of an ongoing funding mechanism for research and watershed management activities, for use primarily in Delaware Bay watersheds. Funds would be applied as match against federal dollars for the management conferences.
- d. Provision of sufficient staffing to manage and monitor progress on National Estuary Program efforts.

## Lake Management and Restoration

### Introduction

Lakes are essential to our ecosystem. Their waters are home to many fish, wildlife, and plants. We enjoy their beauty and we use them for recreation. Like all nature, lakes change over time. As they grow older, they accumulate nutrients and silt, eventually evolving from lakes to wetlands to dry land. Called eutrophication, this natural process normally takes hundreds of years. Detergents, fertilizers, wastes, construction, farming, mining and other human activities have dramatically speeded up this aging process. Cultural eutrophication, the term now used to describe these human effects, has degraded hundreds of lakes and put thousands of others at risk nationally. Sixty-eight percent of the 800 lakes studied by the National Eutrophication Survey (1972-77) were eutrophic to some degree.

The symptoms of such premature aging are easily recognized: masses of plants that prevent a boat or a swimmer from moving through the water, green scum on the water surface, odors from decaying plants, reduced lake depth, dead fish, taste problems in a municipal water supply.

These characteristics do not necessarily signal the death of a lake; rather, they call for analysis and treatment. The relatively new science of limnology (the study of lakes) has proven that wise management can retard eutrophication and significantly prolong a lake's life. Within the past decade the federal clean lakes program has demonstrated how limnological techniques can be used to restore deteriorating lakes.

### The Clean Lakes Program

Recognizing the importance of lakes to the American public and the need to protect and restore them, EPA implemented a clean lakes program in 1975. The program encouraged the states to (1) survey and classify publicly-owned lakes according to trophic condition, (2) define pollution problems, (3) develop pollution control and restoration programs, and (4) execute lake restoration and eutrophication control projects. Delaware received \$74,000 to prepare a classification study for its public lakes; a report was completed in 1980.



Having established the need and demonstrated some effective restoration techniques EPA issued clean lakes regulations in 1980 that set up a three-phased program: To date, Delaware has completed one Phase I (diagnostic) study (for Milford Chain of Lakes) and is conducting another (Silver Lake — Dover).

### **A Public/Private Partnership**

Grass roots involvement is key to the clean lakes program, which is designed to respond to local needs. Citizen complaints about their lake or lakes may be the first step toward securing a federal grant. Because of the requirement for a state/local match, local community support is vital. Most projects receive their institutional and financial support from some local unit of government, such as a city/county lake board or watershed district. In states that fund clean lakes projects, citizen commitment may be in the form of persuading their local or state politicians to appropriate monies to match the federal funds.

### **Delaware's Clean Lakes Program**

Although long concerned with management of the aquatic weeds and fish populations in Delaware's public ponds, the State, heretofore, has not pursued restoration activities through the auspices of the federal clean lakes program. DNREC's Division of Fish and Wildlife conducts ongoing activities for state-owned lakes including fish surveys, fish stocking and aquatic weed/algae control and in conjunction with the Division of Soil and Water Conservation, have undertaken lake improvement projects (through sediment removal) for a handful of lakes. However, coordinated and detailed basinwide attention to lake/watershed management has not been consistently practiced. In light of the obvious ecological and recreational characteristics of our lake and ponds, heightened efforts are in order.

#### **RECOMMENDATION**

DEVELOP AND IMPLEMENT A COMPREHENSIVE STATEWIDE LAKE MANAGEMENT/RESTORATION PROGRAM. THIS PROGRAM WOULD UTILIZE STATE, LOCAL AND FEDERAL (AS AVAILABLE) FUNDING TO PROTECT DELAWARE PUBLIC LAKES. NEEDS INCLUDE:

- a. Resources to match available EPA monies on eligible projects and to administer the program.
- b. Coordination among agencies involved in all aspects of lake management.
- c. Education of lakeside and upstream landowners regarding land-disturbing activities and their impact on lake quality.
- d. An updated lake classification study and framework for Phase I work, undertaken on a statewide basis. The goal would be to fund and complete the balance of Phase I (diagnostic) work in-state and utilize EPA monies solely for Phase II (restoration/management) actions.
- e. Provisions for public access to the state's lakes for recreation.

# Natural Heritage Programs: Preservation of Biological Diversity

## Introduction

Our society is going through a period of unprecedented growth in population, in technology and in consumption. Along with this growth comes a reduction of biological diversity through the loss of plant and animal species and natural communities. Most of the reduction of biological diversity is through the destruction of natural habitats by conversion of natural landscapes to more intensive land uses. The protection of lands through wise land use planning, where natural conditions are allowed to prevail, is essential. These natural areas provide endangered species habitat, scientific research sites, reservoirs of native ecosystems, critical areas benefiting the environment, and buffers against modern-day pressures. The loss of such critical and unique areas is irreversible.

Each species found in these natural lands is unique with its own attributes and may prove to be a renewable resource of practical significance in human affairs. Beyond the intrinsic values of each species and accompanying natural systems, our quality of life is enriched by having an array of diverse natural landscapes. The preservation of natural diversity is a far-reaching responsibility involving a well-defined and coordinated effort on the part of many groups, public and private. The preservation of our natural heritage--our biological and ecological diversity--is a crucial legacy for future generations.

## Natural Heritage Programs

The natural heritage programs of DNREC's Division of Parks and Recreation are directed toward preserving this part of Delaware's environmental legacy. These programs - Natural Areas Preservation, Rare Plant Conservation and Heritage Inventory - complement each other by protecting land containing the best examples of our native flora and fauna and outstanding natural communities.

The Natural Areas Preservation Program's Purpose is to preserve portions of Delaware's landscape containing unique or significant examples of our diverse natural heritage: unspoiled wetlands, old growth forests, rare plant and animal communities, and geological or archaeological sites. In 1978 the Delaware legislature established the Natural Areas Preservation System Act. The Office of Nature Preserves in the Division of Parks and Recreation, assisted by the Natural Areas Advisory Council, a group of private citizens appointed by the governor, directs the program. Voluntary protection of outstanding natural areas is encouraged by a 3-step process: (1) Inventory - locate the most significant natural areas; (2) Registration - recognition by the state and landowner of the significance of the area and a good faith agreement to protect it; (3) Dedication - permanent legal restrictions placed on the area through a conservation easement or articles of dedication. Once a natural area is dedicated then it becomes a nature preserve. The Natural Areas Advisory Council adopted as the state's initial inventory of natural areas, the sites contained in a book published in 1978 by the Delaware Nature Education Society. This book, Delaware's Outstanding Natural Areas and Their Preservation, listed 101 areas statewide worthy of protection. From 1978 to 1987 the official state inventory has undergone some changes. Nine of the original 101 sites have been removed from the inventory because of destruction or loss of natural values. Five new areas, however, have been added to the inventory which now stands at 97 sites. Thirty of the sites have been entirely or partially registered. Seven sites, totaling 822 acres, have been dedicated as nature preserves.

A second major program is Delaware's Rare Plant Conservation Program which is directed at native plant species that are rare from a state, regional or national perspective. A rare species is defined as one that is critically imperiled because it is found in five or fewer occurrences statewide or because some factor makes it especially vulnerable to complete destruction.

Of the more than 1700 native vascular plants in Delaware over ten percent are rare from a state or regional perspective and about one percent are rare from a national perspective. For example, Delaware has one of the three known locations in the world for Hirst's panic grass (Panicum hirstii). Another species, awned meadowbeauty (Rhexia aristosa) is found in only two spots in Delaware.

The third major program is Heritage Inventory. The Heritage Inventory aids in prioritizing protection strategies for the state's rare plant and animal species and significant natural areas. Through a ranking system it develops a list of sites that need protection through acquisition, land management agreement or voluntary landowner activity. In 1986 the Office of Nature Preserves signed a memorandum of understanding with The Nature Conservancy, a nonprofit national conservation organization, to implement a heritage inventory. As part of a national database organized by The Nature Conservancy, the Office of Nature Preserves is able to coordinate information and research on a regional basis. Site-specific field reports are reviewed to see if this is the best occurrence for a species or if a site is adequately protected or if it is in need of immediate action to preserve it. By maintaining an updated database, decisions can be directed towards developing preservation objectives rather than reacting to environmental threats. Presently, the heritage inventory, a computer-assisted database, contains information on rare plants and natural areas. Future work will be directed at critical vertebrate and invertebrate populations.

It is important that the basic information on natural areas and associated biological diversity be integrated into a broader land use - environmental perspective. The data of the natural heritage programs are shared with public and private organizations for environmental review and land use policy decisions. Knowing the location of rare species and critical habitats helps determine what lands are safe to develop.

## Funding

The only source of funding for natural heritage programs and staff and a source of match funding for limited federal money for rare plant conservation is the Nongame Wildlife, Endangered Species, Natural Areas Preservation Fund. This is a voluntary state income tax checkoff. The first year of the tax checkoff (tax year 1983) generated about \$85,000; the second and third year contributions were about \$60,000 each. The decrease in contributions was due, in part, to competition from three other tax checkoffs added in tax year 1984. Federal money for rare plant work also decreased from 1986 to 1987. This decrease in tax checkoff and federal money, plus the fact that one half of each year's tax checkoff contributions goes to support nongame wildlife programs in the Division of Fish and Wildlife, severely limits the effectiveness of the natural heritage programs.

## Summary and Conclusions

The state needs to move ahead with full implementation of the natural heritage programs. With an increasing population and economy and a shrinking natural landscape, the potential loss of biological diversity should be of grave concern.

The protection of a critical natural area is often left to the voluntary cooperation of the landowner. More landowner contact is needed to inform and encourage wise stewardship practices. Sometimes the only way to protect a site is to purchase it. But money for land acquisition is usually not available.

The only rare plant species that are protected by law are those that are federally listed as endangered or threatened and found on federal land. Delaware does not have any legislation to protect its over 200 rare species.

More basic biological and locational data on rare species and natural communities are important to their protection. Public agencies and private conservation organizations need to support each other in these efforts.

Many times public benefit and private landowner rights are viewed as being at odds when it comes to protecting and conserving our natural heritage. But they do not have to be in opposition. If the issues are presented correctly then it should be convincing that it is necessary and desirable to preserve Delaware's natural heritage for the benefit of present and future generations.

### RECOMMENDATIONS

- RECOMMENDATION 1. ALL OF DELAWARE'S CRITICAL NATURAL AREAS SHOULD BE PROTECTED AS SOON AS POSSIBLE. A FULL ARRAY OF TECHNIQUES, SUCH AS CONSERVATION EASEMENTS, GIFTS OF LAND AND FEE SIMPLE ACQUISITION SHOULD BE USED TO PRESERVE LANDS IN PUBLIC AND PRIVATE OWNERSHIP. Private donors should be afforded lowest ad valorem tax rate.
- RECOMMENDATION 2. LEGISLATION TO PROTECT DELAWARE'S RARE PLANTS AND RARE PLANT HABITATS SHOULD BE DEVELOPED AND ENACTED.
- RECOMMENDATION 3. LOCAL, COUNTY AND STATE PLANNING AGENCIES MUST RECOGNIZE THE NEED TO PROTECT OUR BIOLOGICAL DIVERSITY AND PROVIDE FOR SUCH IN COMPREHENSIVE DEVELOPMENT PLANS AND OTHER LAND USE ACTIONS.
- RECOMMENDATION 4. A STABLE FUNDING SOURCE FOR THE PROTECTION OF A FULL ARRAY OF THE STATE'S BIOLOGICAL DIVERSITY IS ESSENTIAL TO MEET THE LEGISLATIVELY-MANDATED MISSION OF DELAWARE'S NATURAL HERITAGE PROGRAMS. Funds should be appropriated annually for staff, program costs, research, and land acquisition. A dollar for dollar state match should be considered to encourage private contributors to the non-game wildlife, endangered species, natural areas preservation fund.
- RECOMMENDATION 5. A COORDINATED INFORMATION EXCHANGE FROM PUBLIC AND PRIVATE SOURCES ABOUT RARE PLANTS AND ANIMALS AND NATURAL COMMUNITIES SHOULD FLOW TO AND FROM THE HERITAGE INVENTORY.

## **Need for a Holistic Approach to Comprehensive Watershed Management**

While many of man's specific activities in a watershed can have narrow environmental or socioeconomic purposes: dig a ditch to remove water from a low spot in a field to create building sites or to enhance agricultural production; use a herbicide to control a field's weeds; install a bulkhead along a pond shoreline to stop erosion; use an insecticide to reduce the depredations of an agricultural insect pest in a field or to control a mosquito brood in a wetlands; install a storm drain in a town to carry off storm waters; use a fertilizer in a field to increase agricultural production; other components of society or the environment can be adversely affected if such activities are not closely coordinated.

### **Intent of Best Management Strategy (BMS)**

The long-term intent of a BMS is to treat wetlands and surface waters as an asset to be managed for the good of society. This may be achieved through a holistic approach which considers the environmental effects on other organisms, habitats or processes when certain organisms or processes have been targeted for management. (A holistic approach is one which emphasizes the functional relationships between parts and the whole.) It is through such an integrated and comprehensive management approach, which better balances environmental needs, that the natural resources of Delaware's watersheds can best be protected or enhanced.

Water quality, flow regime, habitat structure, and energy sources and processes, that are all a part of any watershed, must be taken into consideration by a BMS. These considerations will lead to: 1) the enhancement of wildlife and fisheries habitat; 2) a reduction in dissolved nutrient runoff, suspended sediment runoff, and the runoff of pesticides, synthetic organic compounds, trace metals, oils, and other contaminants; and 3) the prevention of unjustified conversions of freshwater wetlands.

Actions associated with a BMS involve choosing those best management practices (BMP's) which achieve specific objectives and yet are compatible with other watershed objectives or resources. Areas of particular concern in formulating a BMS include urban storm water discharges, forestry practices, farm practices, and drainage practices.

Several federal, state and local agencies perform comprehensive watershed management planning to achieve both short-term and long-term socioeconomic and environmental results. In particular, the U.S. Soil Conservation Service (SCS) has led much of this planning effort for rural watersheds in Delaware by providing information; responding to requests for assistance; providing soil and water inventory data; developing and evaluating conservation alternatives; assisting in making decisions and establishing policies; and assisting in reevaluating and updating objectives and plans. DNREC's Division of Soil and Water Conservation and the state's three conservation districts have been partners in this comprehensive planning process for rural watersheds. In addition, various task forces, citizen and sportsmen's groups have been involved in several watersheds.

Comprehensive watershed planning is a critical component to Delaware's environmental legacy. Consequently, future planning must give increased emphasis to a balance between environmental consideration (e.g. water quality,

wetlands, fish and wildlife habitat) and socioeconomic concerns. As one step toward achieving this goal, a best management strategy (BMS) for wetlands and surface water resources is recommended.

## Objectives of BMS

A watershed BMS is intended to achieve three general objectives: 1) prevent or lessen further environmental degradation, 2) promote sound management of existing natural resources, and 3) restore some previous environmental conditions. Only those best management practices that are compatible with each other, and have net benefits to a watershed's water quality, flow regime, habitat structure, or energy sources and processes, are part of the BMS. Those current management practices that cannot be incorporated as part of a BMS should be modified or discontinued.

The BMS recommends management practices for four wetland zones along a watershed's course: 1) the upper riparian zone (freshwater streams, creeks, marshes, sloughs, bogs, tableland hardwood swamps, Carolina Bays); 2) mid-course standing water bodies, primarily millponds, lakes and reservoirs; 3) the lower riparian zone (freshwater marshes, nontidal freshwater creeks, tidal freshwater and brackish rivers, bottomland hardwood swamps); and 4) tidal wetlands (salt and brackish marshes). A functioning BMS in the non-watercourse areas of a watershed will help to alleviate some of the environmental problems within one or more of these four watercourse zones (e.g. the use of on-farm grassed waterways can help to reduce millpond sediment loads). However, there are also objectives and methodologies that are specific to one or more of the four watercourse zones (e.g. using chemical herbicides for exotic weed control in millponds). These objectives and methodologies, specific to one or more of the four watercourse zones, are also part of the BMS.

Any success in achieving the BMS's objectives will also depend on factors associated with subsurface ground water, particularly in terms of water quality and flow regime. The beneficial environmental impacts of a BMS should also be eventually realized in the open estuary.

## Specific Watershed Needs and a BMS

The BMS's focus in the upper watershed on farm and forestry practices and drainage ditch management, has much potential for improvement in water quality, wetlands conservation, and fish and wildlife habitat in areas south of the Chesapeake and Delaware Canal (i.e. southern New Castle County and Kent and Sussex Counties). Northern New Castle County (north of the canal) does not lend itself as readily to that approach since its watersheds are not as heavily affected by farm and drainage ditch practices and forestry operations. Because of northern New Castle County's extensive urban development, the most tangible environmental improvements will come from applying those BMS practices associated with urban stormwater management, habitat protection of remaining freshwater and tidal wetlands, and improvements in subsurface ground water quality and point-source surface discharges. Land-use planning in watershed critical areas is an immediate need for northern New Castle County and the inland bays area of Sussex County. Watershed related land-use issues will continue to increase in importance throughout the state. In particular, land-use plans should address residential building in floodplains and environmental alterations associated with such development.

state cooperation with Pennsylvania and Maryland. The upper watersheds of those northern New Castle County streams which lie in Pennsylvania or Maryland (e.g. Christiana River, White Clay Creek, Red Clay Creek, Brandywine Creek) could benefit from BMS environmental practices that are more rural-oriented.

Most of the watersheds south of the canal that flow into Delaware Bay or the inland bays are contained, for the most part, in Delaware, and would not present interstate problems in implementing a BMS. If BMS's for environmental resources are to be more emphasized in those western Delaware watersheds which flow into Chesapeake Bay, it would be an opportunity for Maryland to join in the expanded implementation of BMS's. Maryland would benefit from Delaware's work in what would primarily be upper watershed habitats in Delaware (e.g. Chester River watershed, Choptank River watershed). The Nanticoke River watershed (including Broad and Marshyhope Creeks) has upper, mid, and lower riparian zones within Delaware that could all benefit from a BMS.

#### RECOMMENDATIONS:

- RECOMMENDATION 1. WATERSHED COMPREHENSIVE PLANNING AND MANAGEMENT IN DELAWARE MUST BETTER CONSIDER AND ACCOMMODATE ENVIRONMENTAL INPUT FROM THE FORESTRY SECTION OF THE STATE DEPARTMENT OF AGRICULTURE AND FROM THE VARIOUS DIVISIONS WITHIN DNREC.

Also, because of the Army Corps of Engineers newly active role in Delaware in the 404 permit review process concerning agricultural drainage, the environmental issues of concern to the Corps and to its sister federal permitting agencies, the U.S. Environmental Protection Agency and the U.S. Fish and Wildlife Service, must be considered and accommodated.

- RECOMMENDATION 2. DEVELOP AND IMPLEMENT A PROCESS TO ENSURE THE NECESSARY AGENCY INTERACTION AND COOPERATION REQUIRED FOR IMPLEMENTATION OF A WATERSHED BMS.

The state's existing TEAM organization may be a mechanism for accomplishing this task by initiating, coordinating and monitoring interagency agreements which address environmental issues in comprehensive watershed planning. (TEAM is composed of program administrators and managers from DNREC's Office of the Secretary and its Divisions of Fish and Wildlife, Parks and Recreation, Soil and Water conservation, Air and Waste Management, and Water Resources; from the Delaware Dept. of Agriculture, including Aglands Preservation, Pesticide Compliance, and Forestry; from the U.S. Soil Conservation Service; from the federal Agriculture Stabilization and Conservation Service; from the University of Delaware's Cooperative Extension Service; from the Delaware Dept. of Transportation; and from the three Conservation Districts.) The SCS and the ASCS are the only federal agencies on TEAM; because of the BMS's environmental objectives, it may also be appropriate to add to TEAM representatives from the Army Corps of Engineers, the U.S. Fish and Wildlife Service, and the U.S. Environmental Protection Agency.

# PROTECTING DELAWARE'S SHORELINE

## INTRODUCTION

Delaware's Atlantic coastal beaches protect the most valuable 25 mile strip of real estate in the state, and are the major attraction supporting Delaware's third largest industry — tourism. Shoreline migration, which is driven by a rising sea, threatens the recreation value of Delaware's beaches and makes valuable shore development more susceptible to damage from coastal storms. To stay the loss of our beaches will require intelligent planning and a firm commitment to take action.

The significance of sea level rise is profound. Since the end of the ice age, about 14,000 years ago, the oceans of the world have been rising, causing shoreline migration, low land flooding, loss of wetlands and salt water intrusion into estuaries and fresh water aquifers. There is no way to stop shoreline movement, one can only slow its progress. The problem is getting worse and action needs to be taken now or the problems will be insurmountable in the future.

Since the early part of this century, the state has treated the problem of beach erosion by responding to the needs of individual communities or specific locations. If Rehoboth had storm damage or erosion, for example, the state funded work in Rehoboth. If the bridge at Indian River Inlet was threatened, the state funded work at the bridge. Lacking the current understanding of the natural processes taking place along the shoreline, the state did a reasonable job of treating the symptoms. An increase in knowledge about coastal processes and their effect on the Delaware shore, combined with the vacation home building boom during the last few decades, compels the state to take a new approach to resolving the beach erosion problem.

There are a number of strategies to deal with the beach erosion problem. One way is to let nature take its course. Another is to continue treating problems year by year with available funds. A third way is to "hold the line," keep the beach where it is today - and back that choice with the necessary funds to do so.

## THE KEY SHORELINE PROTECTION ISSUES

### Sea Level Rise and Shoreline Movement

For approximately 14,000 years the ocean has been rising at varying rates pushing the point where the land meets the sea in a landward direction. The marshes and beaches that now make up the Delaware coast were once as far as 100 miles east of their current location. Over time the migration of the shoreline has proceeded with little concern shown by coastal inhabitants. In the last 50 years, however, Delaware's coast has become a major summer recreation haven. With the construction of buildings, roads, and other infrastructure, the persistent movement of the shoreline now presents problems which were not previously experienced.

Two geologic processes cause shoreline movement: (1) the actual rise in ocean levels caused by a gradual melting of the polar ice caps and thermal expansion of the oceans, and (2) the compaction of sediments in the earth's crust which causes the nearshore land surface and the ocean floor to sink. The



combination of these two factors leads to a gradual rise of the ocean and bay relative to Delaware's land area. Over the long term, a landward and upward movement of the barrier beaches has occurred. Figure 25 illustrates this landward movement. As sea level rises, waves begin to attack the beach at a higher elevation causing increased shoreline erosion. At the same time, washover and blowing beach sands continue the process of dune formation. These processes occur slowly enough so that the dune's position relative to the shoreline is maintained. But the net result is a gradual landward and upward movement of the beach and dune line. To give some scale to this ongoing effect, sea level has risen approximately 440 feet during the past 12,000 to 14,000 years. Centuries ago, the shoreline of Delaware lay seaward on the edge of the outer Atlantic Continental Shelf approximately 80-100 miles east of Rehoboth Beach.

The rate of rise and slope of the land determines how fast the shoreline migrates. Many scientists now agree that an increase in the rate of sea level rise and, hence, an increase in the rate of shoreline migration, will happen in the coming decades due to an increase in concentrations of carbon dioxide and other "greenhouse" gases in the atmosphere. There is debate over what the rate of acceleration will be, but at least a doubling of the last 100 year's rate can be expected over the next century. Studies have suggested that sea level rise in the middle Atlantic states has been at the rate of 13 inches per century. This is more than double the rate of the past 2,000 years which was six inches per century.

A number of scientists have developed mathematical models to predict sea level rise based on the increasing concentration of gases. The results of one of these models is shown in Table 1 and indicates that sea level could increase as little as 22 inches or as much as 136 inches by the year 2100.

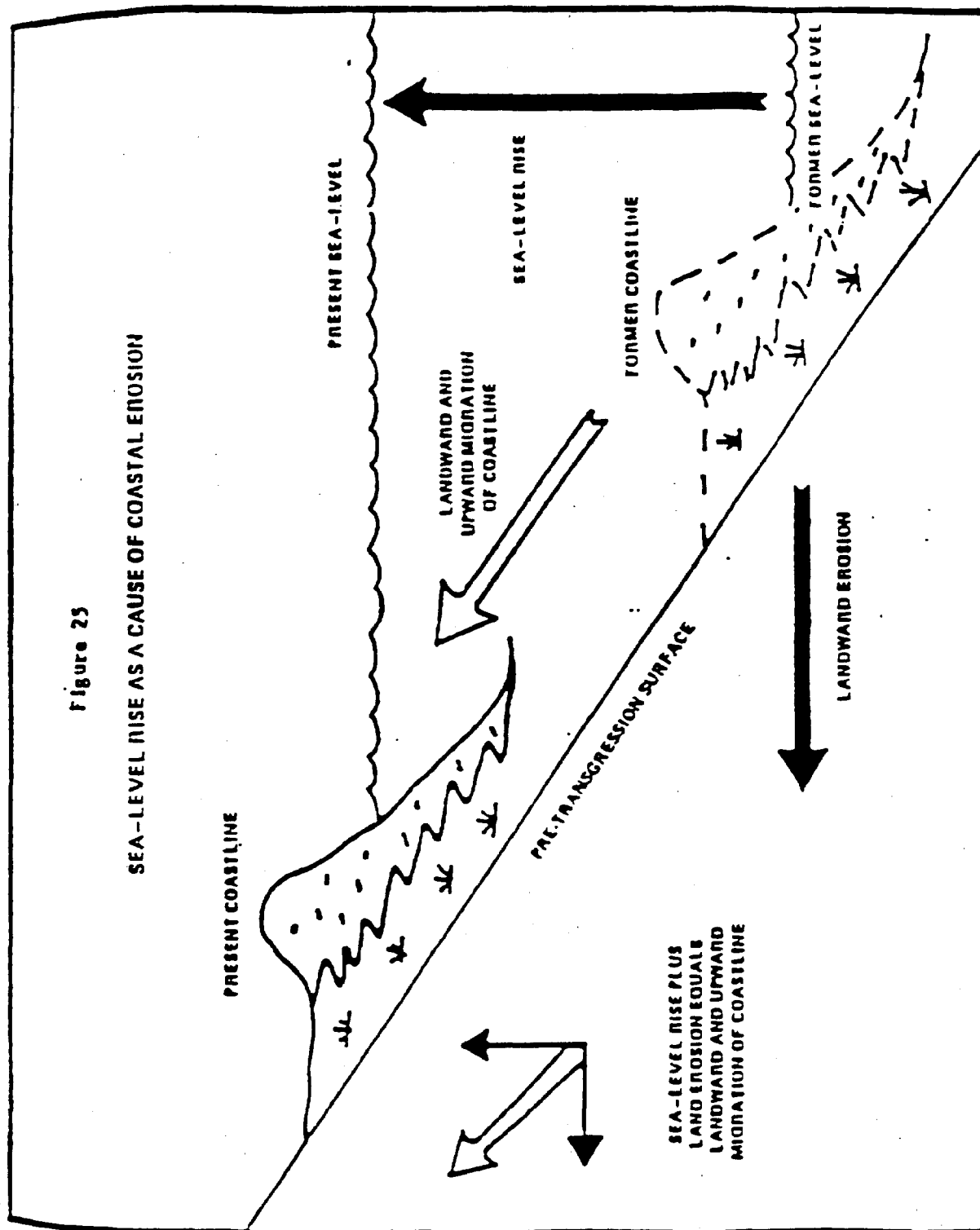
TABLE 1

Estimated Sea Level Rise, 2000 — 2100, by Scenario (inches)

Year	Historical	Conservative	Mid-Range Scenarios		High Scenario
	Extrapolation		Moderate	High	
2000	0.8 - 1.2	1.9	3.5	5.2	6.7
2025	1.8 - 3.2	5.1	10.3	15.5	21.6
2050	2.8 - 4.7	9.4	20.6	30.9	45.9
2075	3.7 - 6.1	15.0	35.9	53.9	83.7
2100	4.7 - 7.1	22.1	56.9	85.3	135.8

Source: J. Hoffman, D. Keyes, and H. Titus, 1983, Protecting Future Sea Level Rise: Methodology, Estimates to the Year 2100, and Research Needs, 2nd rev. ed. U. S. GPO No. 055-000-00236-3, Washington, D. C.: Government Printing Office.

Neither of these scenarios is likely to occur and sea level rise is expected to fall somewhere between the two mid-range positions (57 to 85 inches). However, such a rise represents an 8 to 18 fold increase over the average sea level rise experienced over the past 100 years. Even the conservative (unlikely) scenario



represents a three to five fold increase over the historic rate. When one considers the impact on coastal properties caused by the relatively low historic rate, it is disturbing to contemplate what the future holds at the higher rates.

Regardless of what the future rate of sea level rise will be, migration of the coast is now threatening existing development, the future existence of recreational and protective beach, wetlands, the availability of fresh water supplies, the successful functioning of septic systems and the future of certain roads, highways, and bridges.

Problems related to shoreline migration have not been uniformly experienced along the coast. Due to localized variables some sections of Delaware's coastline have remained fairly stable while others have experienced a large amount of erosion over the last several decades. Shoreline movement in some locations has been characterized by several years of relative stability followed by several years of rapid erosion. For example, Fenwick Island, has been relatively stable for many years, but in the past 5 years the beach has moved over 60 feet.

At South Bethany, sea level rise and beach migration has resulted in homes standing virtually at the water's edge. Over the last decade South Bethany has lost a portion of the road running parallel to the beach from storms, resulting in broken sewer laterals and allowing salt water to enter the sewer main. Moreover, well heads have been sheared off during storms permitting salt water to infiltrate wells. In a few more years of shoreline movement the only dry beach in South Bethany will exist among the pilings under houses.

If no action is taken, it's only a matter of time before other ocean and bayfront communities find themselves in a similar situation as South Bethany. For example, on three occasions during the summer of 1987 high tides reached the point where there was little or no dry beach in Fenwick, South Bethany, Bethany, and Rehoboth. Those situations were not associated with storms, but merely a higher than average high tide combined with a lower than average beach width and elevation. After severe coastal storms, Fenwick Island, South Bethany, Bethany Beach, Dewey Beach, Rehoboth Beach and many of the Delaware Bay communities have had to deal with sand and debris on the roads and in storm sewers. The Delaware Bay coast communities are often cut off by flooding. All such problems will become more frequent in future decades as sea level continues to rise at, perhaps, even higher rates.

A National Academy of Sciences report has recently suggested that historic rates of sea level rise could continue for about the next 50 years, but beyond 50 years a rapid increase is expected. At some point in the next century, building lots, which are now immediately adjacent to the Atlantic Ocean and Delaware Bay shoreline, will be under water. The storms which will strike the coast will cause increasing amounts of damage to buildings, roads and other infrastructure. Although inevitable, the specific timing is unpredictable.

## **Economic Impacts of Beach Erosion**

Delawareans and visitors have long regarded the beaches and coast as the sparkle in the Diamond State. Tourism is now the third largest industry in the state with 1985 revenues of \$660 million. Delaware Seashore State Park, Cape Henlopen State Park, and Fenwick Island State Park had 1,068,852, 446,128 and 93,768 visitors, respectively, in 1986. Rehoboth, Bethany, and Fenwick provided

recreational opportunities to uncounted numbers of people. It would be devastating to the economy of Delaware if the beach disappeared or existed only under houses or boardwalks.

Single undeveloped oceanfront lots measuring 75 feet wide north of Bethany Beach are currently selling for \$525,000. As a rough estimate, the value of oceanfront lots and structures exclusive of boardwalks, shore protection structures and infrastructure is estimated at \$52,750,000 in Fenwick Island, \$39,400,000 in South Bethany, \$93,340,000 in Bethany, \$47,000,000 in Dewey Beach. Combine those figures with the unknown values of property in the Rehoboth, Fenwick Acres area, Middlesex Beach, Sea Colony, Sussex Shores, North Bethany area, Indian Beach, Henlopen Acres/North Shores, Lewes, Broadkill, Primehook, Slaughter Beach, Bowers, Kitts Hummock and Pickering Beach, and the totals represent a staggering value in real estate. Clearly, the loss of Delaware's beaches to erosion and shoreline migration will have a very significant economic impact.

## **Other Impacts**

Improper management of the sandy portions of the shoreline could make the wetlands (which are often protected from wave erosion by beaches and dunes) more vulnerable to destruction. Marshes exposed to wave attack erode at a very fast rate. Significant loss of wetlands would greatly affect the ecological processes so necessary to fisheries and other living organisms.

Sea level rise will eventually threaten many roads, pipelines, bridge approaches, sewers, water mains and other infrastructure. There is a real threat that roads such as Route 1 from Rehoboth to Fenwick will have to be abandoned at some point in the future. Fresh water supplies for some coastal areas could become contaminated with salt to the point where they would be unuseable.

## **CURRENT SHORELINE MANAGEMENT POLICY**

The problem of shoreline movement is currently being addressed by the DNREC under provisions of the Beach Preservation Act (7 Delaware Code (Ch. 68)). The Beach Preservation Act created a Beach Preservation Fund (at least \$1,000,000 at the beginning of each fiscal year). The DNREC regulates construction on all beaches and dunes and restricts activities detrimental to the dune/beach system. Three major beach management programs are administered: (1) regulation of construction and enforcement; (2) long term project planning and construction; and (3) dune/beach maintenance.

## **Construction, Regulation and Enforcement**

This program is designed to restrict construction in areas landward of the dune so that an adequate buffer between the construction and water will exist, and to minimize construction impacts on the dune when it is necessary to build in the dune area. Restriction of construction activities to locations well behind the dune allows many years to pass before the erosion problem necessitates costly corrective action. Permit requirements for construction in the dune or beach zone include conditions designed to minimize impacts on the natural function of the dune, the underlying concept being that the best defense against storms is a wide beach and a full dune. The regulations fall short of attaining the goal of restricting all structures to locations landward of the dune. Success has been achieved where new subdivisions have occurred, for example in the North Bethany area. In older communities, however, lots

subdivided decades ago are sometimes entirely seaward of the dune. The DNREC is impelled to grant a permit for construction in these locations even if it may be in the middle of the beach, due to the constitutional protection from taking private property without compensation.

The regulations also fall short of protecting the dune and beach for long periods of time, even in areas where construction is kept landward of the dune. Eventual shifting of the dune and beach results in houses standing literally on the beach or at the water's edge. Due to traditionally austere staff resources, enforcement of regulations has generally been restricted to flagrant violations.

As time passes and property values increase, the severity of the problem increases. In addition public recreational beach areas become narrower while the number of beach users becomes larger and the potential for major storm disaster along the coast stands at an all time high.

Eventually, most beach front residents appeal to the state for financial help in carrying out property repairs. If a commitment of more state and local funding is made to assist these people, then it seems reasonable for the state to assume more control over the construction which has created the problem in the first place. Stricter regulations and local zoning ordinances can help in reducing the problem. Improvement in the enforcement of regulations should also be made.

The basic intent and function of the regulatory program has remained relatively unchanged since its inception in 1974 -- a one person program attempting to limit construction to an area behind the dune. The successes of the program, when looked at relative to the expected physical life span of the structures being built, are short lived. Houses being built in the North Bethany area will in all likelihood stand long enough to experience the migration of the dune and beach to the point where houses will be over the water for an appreciable period of the year - as ocean front houses in South Bethany are today. Effective long-term success through the regulatory program has been and will continue to be difficult to attain, primarily due to constitutional protection against the taking of private property and the highly dynamic and overwhelming nature of natural forces along the coast.

## Project Planning and Construction

As part of its overall beach preservation program, the DNREC carries out projects to mitigate beach erosion and shoreline migration. These projects have primarily been groin construction and repair and beach nourishment. The location and extent of the projects are largely dictated by need and available funds. While funds appropriated annually for beach preservation projects have varied over the years, they have averaged about \$500,000 a year over the last few years. In addition to the state's beach preservation efforts, there have been attempts by private and municipal interests to mitigate beach erosion through the construction of groins and to protect upland areas adjacent to eroding beaches by constructing bulkheads and rip-rap revetments.

The limited amount of beach preservation funds made available has severely hampered the extent of beach preservation activities on the oceanfront because of the high cost of doing work there. Projects on the oceanfront have generally been limited to the construction or repair of groins and beach nourishment at Indian River Inlet where cooperation with the federal government and the sheltered working area provided by the interior of the inlet have allowed for affordable projects.

Prior to 1985, the state traditionally paid for 100% of the cost of beach preservation measures on publicly owned or dedicated lands and 100% of the local share of federally cost shared projects. Beginning with Fiscal Year 1985 language attached to the beach preservation appropriation has required the DNREC to give priority to projects where local or county governments pledge equal funds. To date the only local government which has pledged matching funds has been South Bethany. This policy has advantages and disadvantages. Advantages are that it reduces the amount of state funds required for a project and requires local governments to demonstrate a commitment. Disadvantages are that project design will be governed by (1) the amount of funds available from the local government and (2) political boundaries, rather than technical considerations. Moreover, limited state beach preservation funds may be tied up by a long-term commitment for matching local contributions. The disadvantages lead the DNREC into a situation where it finds itself committing state funds to projects that would otherwise be considered only after more deserving projects were completed.

### **Annual Dune/Beach Maintenance Program**

Vegetation growing adjacent to the beach acts as a sand trap when the wind blows at sufficient velocity to move the sand. Dunes form where the vegetation traps the sand. The vegetation grows out onto the beach as far as storm driven tides will allow. The amount of wave and tide activity impacting the beach, the velocity and direction of the wind blowing across the beach, and the quantity of sand determine the dimensions of the dune and beach. The dune maintenance program of the DNREC attempts to enhance and protect the dunes because of their value in absorbing moderate storm energy thereby providing protection to landward development.

The annual dune maintenance program consists of mechanically rebuilding dunes lost from storms; planting dune grass on newly built dunes and denuded areas; constructing and maintaining pedestrian and vehicle dune crossovers on public lands and lands open to public use; fencing to keep people off the dunes and to help sand accumulate on the dunes; and posting signs informing people to stay off the dunes. This work is carried out in the coastal State parks as well as at Ferwick Island, Dewey Beach, Rehoboth, Lewes, Broadkill, Slaughter Beach, South Bowers, Bowers, Kitts Hummock and Pickering Beach.

### **OPTIONS FOR RESOLVING THE BEACH EROSION PROBLEM**

When reviewing the various options available for resolving the beach erosion problem, it is tempting to ignore the current status of development and through hindsight say how things should have been done. Unfortunately planning must deal with the conditions that exist today. There is a great deal of misconception, mysticism and generally confused thinking surrounding beach erosion control and the problem is often approached on an emotional rather than a scientific basis. Amateurish schemes for erosion control abound. The reason for the uncertainties about how to deal with the problem is that erosion control is far from an exact science. Professionals in the field are quick to point out that although there is a large pool of scientific information on beach erosion, understanding its causes and the effects of restoration and protection techniques must be substantially improved.

Three types of actions should be considered to maintain and protect Delaware's beaches. They are strategic retreat, hardening of the shoreline, and beach nourishment. These methods can be used individually or in some combination with each other.

## Strategic Retreat

Strategic retreat means moving structures away from the waterfront as natural beach migration occurs. Over a period of decades consecutive rows of structures parallel to the shore would be evacuated leaving an open beach seaward of remaining development. While this deals realistically with the problem a number of political, economic and social considerations stand in the way of making this a practical solution.

If strategic retreat was employed, one would have to determine where to move the houses. Along the Delaware coast there are not enough vacant lots left in some communities to accommodate houses moved from the waterfront. Moreover, ocean front lots in some communities support condominium buildings and hotels which either could not realistically be moved, or would be inappropriate located elsewhere.

Another problem relates to who pays the moving and land procurement costs. If strategic retreat was adopted as policy the state would most likely be compelled to underwrite such actions. If the property owner was required to pick up the tab for strategic retreat then the state could force such action by adopting a no action policy which would in effect allow beach migration to catch up with shoreline structures to the point where structures were sitting in the water, destroyed or moved away. At some point, property owners would be required to clear the beach of their structure (or what was left of it) in order to maintain an open beach. The next row of houses would begin anew the cycle of encroaching sea and eventual loss.

## Hardening of the Shoreline

Hardening of the shoreline refers to construction of engineered erosion control devices such as groins, jetties, sea walls, bulkheads, revetments, breakwaters, etc. to mitigate the effects of storms and beach erosion.

Generally the placement of these structures is done to protect development, but they do not necessarily protect the beach. While such structures can be useful in protecting development adjacent to the beach, the structure itself can cause an increase in the rate of beach loss. Both the state and private individuals have used this form of protection in Delaware. Groin fields have been constructed and maintained by the state in Bethany, Rehoboth, Lewes, Broadkill Beach and Slaughter Beach. Bulkheads and revetments have been built by homeowners in South Bethany, Bethany, Lewes, and Slaughter Beach. As sea level rises and beach erosion continues seaward of hard structures, the dry sand beach just disappears. Marmouth, Sea Bright and North Cape May, New Jersey are good examples of an advanced stage of shoreline hardening. Sea walls protecting roads and houses are fronted by ocean with no beach. Residents living behind the wall must drive several miles to use a beach. Hardening of the coast by itself will eventually result in the loss of the beach unless a commitment to beach nourishment is also made.

## Beach Nourishment

Beach nourishment is the process of adding sand to a particular segment of the beach to restore it to its former width. The most common form of nourishment is accomplished by dredging sand offshore and depositing it on the beach. Truck hauled sand from onshore sources and barge hauled sand have also been utilized. Beach nourishment, of course, does not stop the erosion trend, it simply provides more time before erosion catches up with structures. Beach nourishment achieves both goals of providing a wide recreational beach area and reasonable storm protection to landward development. To be effective over the long term, a beach nourishment project must be periodically maintained by renourishment. After a beach is nourished a storm may occur resulting in the loss of the newly built beach and a return to the starting point. Beach nourishment is currently the form of shore protection most advocated by coastal engineers and geologists. To increase the benefits of a beach nourishment project, retention structures such as groins may be required to hold the sand where it is supposed to stay. The combination of hardening the shoreline and beach nourishment may provide optimum results in some locations.

## Beach Management Goal

TO ASSURE THE CONTINUED EXISTENCE OF BEACHES IN DELAWARE THAT WILL PROVIDE FOR ANTICIPATED RECREATIONAL NEEDS AND A COST-EFFECTIVE LEVEL OF STORM PROTECTION FOR COASTAL PROPERTIES, STRUCTURES AND INFRASTRUCTURE FOR THE NEXT 25+ YEARS.

### RECOMMENDATIONS

RECOMMENDATION 1. THE STATE SHOULD DEVELOP A STRATEGIC MANAGEMENT PLAN FOR DELAWARE'S ATLANTIC OCEAN AND DELAWARE BAY BEACHES WHICH WOULD:

- a. Determine the nature and extent of the natural and human causes of beach erosion, the current general condition of Delaware's beaches and the range of likely scenarios of change due to natural factors for 25-50-100 years into the future.
- b. Quantify the economic importance of Delaware's beaches.
- c. Examine options to deal with beach erosion and select the most cost effective option (or combination of options) for Delaware to implement.
- d. Provide public education.

An analysis of a number of sea level rise scenarios based upon data available from the Environmental Protection Agency and the National Academy of Sciences and their possible long term effects on Delaware's coastline if nature were allowed to take its course should be made. The study would examine expected property losses and values and expected shoreline locations at various times in the future. The study would look into development of a range of options for dealing with the problem over the long term; the costs of implementing each option in light of accelerating sea level rise; the



public and private benefits which would accrue; and the social, political, and economic problems created. Development of the master plan should begin as soon as possible and completed within one year. Recommended starting date for developing the plan is April, 1988.

This recommendation is made with the understanding that eventually a significant increase in the rate of sea level rise or the changes wrought by a major storm may render any beach management plan obsolete requiring new directions of thought.

- RECOMMENDATION 2. THE CURRENT STATE BEACH PROTECTION PROGRAM SHOULD PROCEED ACCORDING TO SCHEDULE. AREAS IDENTIFIED AS NEEDING IMMEDIATE ATTENTION INCLUDE FENWICK ISLAND, SOUTH BETHANY, AND BETHANY BEACH.

Funds for beach preservation projects have already been requested for those areas. Development of a master plan should not be used as a reason for delaying action in communities which are considered to have critical beach erosion problems.

- RECOMMENDATION 3. THE STATE SHOULD EXAMINE WAYS TO PROVIDE ADEQUATE, STABLE AND EQUITABLE FUNDING TO CARRYOUT RECOMMENDATIONS OF THE COMPREHENSIVE BEACH MANAGEMENT PLAN.

An analysis of methods to finance implementation of the management plan including guidelines for cost sharing between state and local governments should be made. Each beach management option has costs and benefits associated with it, and the costs and benefits accrue partially to the general public and partially to identifiable private parties. Equity suggests that the parties who derive benefits from publicly sponsored beach management programs should bear their fair share of the costs. An equitable cost share arrangement should be established for beach projects which requires a percentage of the total cost be paid from local contributions. The local contribution could come from any combination of private, municipal and county funds. The local share could be generated by a number of sources including special tax districts, hotel or room taxes, user fees assessment of property owners or existing tax revenues. This financial analysis should begin before completion of the management plan, utilizing cost information as it is developed.

- RECOMMENDATION 4. THE GOVERNOR SHOULD APPOINT A BODY OF KEY ADVISORS TO HELP OVERSEE DEVELOPMENT AND IMPLEMENTATION OF THE COMPREHENSIVE BEACH MANAGEMENT PLAN.

A key responsibility of this group would be to promote public awareness of the many issues surrounding future protection of Delaware's beaches.

RECOMMENDATION 5. THE STATE SHOULD CONSIDER ESTABLISHING A COOPERATIVE RESEARCH CENTER WITH THE UNIVERSITY OF DELAWARE.

Because of the long term nature of this problem and the many uncertainties related to sea level rise and other physical factors, continuing study and research is needed to assure continued reliability of the comprehensive beach management plan and its recommendations.

# AGRICULTURAL LANDS AND THE ENVIRONMENT

## INTRODUCTION

Delaware's agricultural lands are a major, irreplaceable resource which has faced increasing pressure over the last seventy years. For three centuries, Delaware's fertile soils have been the cornerstone of the state's economy. What some may not appreciate, however, is that agricultural lands are also a keystone to what helps hold our environmental resources together. Agricultural lands occupy over half (52%) of Delaware's land area, so what happens on the farm can favorably or unfavorably affect much of the state's environment. Croplands and forestlands provide open spaces for air quality enhancement and water filtering, retention and recharge to Delaware's aquifers. Woodlands, wetlands and field edges provide habitat for wildlife and a home for rare and endangered plants and animals. Farmlands provide recreation for hunters, bird watchers and hikers. Farmlands can also provide buffer zones for wetland and stream protection. While Delaware farm lands provide all these environmental benefits, above all else, they provide food. Clearly, farming and the environment depend on each other. Making the best environmental use of land and water is not always easy for farmers who must cope with weather, pests, disease, price risk, interest rates, farmland values and cash flow problems.

Looking ahead to the year 2000, the big question is: Can Delaware farmers sustain a high level of profitable food production while also protecting the quantity and quality of the natural resources on which farming depends? Probably not, unless Delaware agriculture gets more attention in land use and transportation planning and economic development.

While the availability and quality of natural resources affects agriculture, farming in turn affects the environment. For example, improper animal waste utilization or disposal; overuse of nitrogen and phosphorus fertilizers, and pesticides; stormwater runoff, erosion, and sedimentation are significant pollution sources. Emerging technology and better management can reduce the environmental pollution attributed to agriculture, but more farmers must adopt better management practices, especially in the vicinity of fragile environments like the inland bays of Sussex County and in locations where there is a high potential for groundwater contamination.

Farming is also on the receiving end of environmental pollution. Besides sharing in the broad public concern over water quality, agriculture can suffer the effects of air pollution, including acid rain, ozone, and other emissions. Application of sewage sludge and septage to farmland can pose serious health and environmental problems unless carefully controlled and monitored. To maintain the balance between requirements for food production and environmental quality, farmers will need more technology as well as instruction on how to apply that technology.

Farm finances also cloud the scene. Agricultural resource management exists within an environment complicated by today's difficult economic conditions in much of agriculture where even good managers are hard pressed to maintain profitable farm operations. Many farm families are unable to devote proper attention to resource management while survival of the farm business preoccupies their thoughts and budgets.

# AGRICULTURAL PRACTICES THAT CAN AFFECT THE ENVIRONMENT

## Erosion and Sediment Control

The predominant soil erosion control practice used in Delaware is conservation tillage. The ultimate in conservation tillage is no-till where crops are produced with minimal disturbance of the soil. Delaware leads the nation in percent of croplands under conservation tillage. Over 80% of all crops planted in 1986 used conservation tillage and about 50% of that figure used no-till. Conservation tillage can cut erosion in half when compared to conventional tillage in a corn field. No-till reduces the erosion another 50%.

Although conservation tillage is effective and used extensively in Delaware, it is not a panacea. A conservation system consisting of various practices must be tailored, applied, and maintained in each field for effective erosion and sediment control. Other practices used in Delaware include grassed waterways, grade stabilization structures, windbreaks, crop rotation, contour farming, cropland terracing, water and sediment control basins.

The 1985 National Farm Bill requires farmers to develop and carry out conservation plans on highly erodible land or lose their eligibility for USDA commodity programs. There are an estimated 38,000 acres of cropland in Delaware (out of a total estimated 500,000 acres of cropland) which meet the highly erodible definition with 80% in New Castle County. Plans designed to stabilize those fields with the highest potential for soil erosion must be implemented by 1995. The conservation compliance provision is not yet well understood by farm operators and even less so by absentee landlords. Landlords renting out cropland may have difficulty finding renters after 1990 unless the landlords have adopted approved conservation plans.

Excessive wind and water erosion of soil may again threaten farmland quality in Delaware as elsewhere. This will happen if grain prices rise sufficiently to stimulate additional grain production. Farmers who want to expand grain production often will till marginal land, or purchase or rent land at exceptionally high prices, both of which discourage soil conservation.

Controlling erosion and sediment requires coordination among the county conservation districts, the Department of Natural Resources and Environmental Control, the Department of Agriculture, U.S. Soil Conservation Service, Agriculture Stabilization and Conservation Service, and the Cooperative Extension Service.

Conservation plans have been developed for over 500,000 acres of rural land in Delaware. Unfortunately, an estimated 50% of these plans need significant revision to bring them up to date. The Statewide Nonpoint Source Management Plan currently being developed by DNREC should, after implementation, help to substantially reduce water quality problems associated with agricultural practices. This plan is scheduled for completion and implementation by October, 1988.

Two cost-sharing programs assist Delaware farmers and other landowners to install soil erosion control practices. The Agriculture Conservation Program, a federal program administered by ASCS, provides about \$200,000 of cost-share funds each year to farmers for a variety of practices, most with erosion control objectives.

The second program, started in 1985, is administered by the DNREC, Division of Soil and Water Conservation through the conservation districts. This program provides annual cost-sharing funds (\$315,000 for fiscal year 1988) for conservation practices. Both programs generally cost-share on a dollar for dollar basis.

## **Irrigation**

Agricultural water use in the state will likely increase in the future. During the past ten years, irrigated cropland has increased to an estimated 60,000 acres (12% of all cropland) along with increased capacity of irrigation systems. Recent droughts have accelerated the amount of water withdrawn by those systems. Most of the increase in irrigation comes from groundwater, though irrigation with surface water is also increasing.

In the future farmers will most likely want more irrigation water; however, the cost of energy may provide an economic constraint against overpumping. Future ratios of energy costs to crop prices (along with costs of financing) will influence whether farmers invest in irrigation. However, steady increases in irrigation along with other water demands create the potential for conflict among users.

In Delaware's humid climate, irrigation must be managed differently than in drier regions. Delaware farmers need to use methods that minimize leaching of nitrogen into groundwater while making sure crops get enough nitrogen and water. This is especially important considering the state's sandy soils. On sloping lands, care must be taken not to increase erosion when irrigating. Because of the climate, erosion can be severe when unexpected rainfall follows irrigation. Plant disease, insect and weed control are other problems that irrigation management must contend with in humid regions.

## **Nutrient Management**

Poultry manure disposal is a constant challenge as the broiler industry seeks to minimize environmental contamination from broiler farms. The industry's regional trade association, Delmarva Poultry Industry, Inc., has funded limited research on poultry manure. In addition, the DNREC has underwritten studies by the University of Delaware to seek better ways to manage this problem.

Nearly a million tons of manure are produced annually from Delaware animal and poultry operations, and this manure has value to farmers as low-cost fertilizer. Each year enough manure is produced to supply the nitrogen requirement for all the corn grown in Delaware. Unfortunately, overuse and improper storage and timing of manure applications have misused a valuable nutrient source and contributed to contamination of surface and groundwaters. A successful nutrient management program would be a significant step toward reducing the nitrate pollution of groundwater in Delaware.

A recent survey of poultry growers throughout the Delmarva peninsula indicates that only 35 percent of growers calibrate their manure spreaders, 15 percent have their manure analyzed for its fertilizer value, 14 percent cover the manure with plastic when stockpiled, and four percent use a manure storage shed. These percentages, however, reflect considerable improvement from a similar 1981 (pre-cost share program period) survey, but there obviously remains much room for improvement.

## Drainage

Drainage in Delaware has long been a necessity to farmers as well as rural and urban communities. Legislative actions authorizing public drainage facilities date back to 1793. Drainage facilities have undoubtedly played a major role in establishing the strong agricultural base of productive land that exists in Delaware today, as well as significantly contributing to the quality of life in Delaware's rural communities.

Delaware currently has about 2,000 miles of organized tax ditches affecting approximately 500,000 acres of watershed area. These ditches provide both direct and indirect benefits to 100,000 people and almost one-half of the state-maintained roads. The 2,000 miles of organized tax ditches are administered by over 200 tax ditch organizations. Tax ditches create a mechanism for restoring old or poorly-functioning drainage systems, for creating new or enlarging systems, and for providing maintenance.

Tax ditches benefit agricultural productivity by creating conditions which either increase yield per acre on prime farmlands, or permit the cultivation of lands that would be unprofitable or impossible to farm if drainage was not available. As such, tax ditches increase the value of many wet rural lands for use as cropland, maintaining the agricultural economic base of rural areas and encouraging the preservation of a rural landscape and a way of life. Moreover, drainage allows better management of agricultural lands including the implementation of best management procedures. However, drainage has also promoted residential development in some wetland areas that would otherwise have been too wet for construction.

Much of the environmental criticism of drainage ditches centers on conversions of freshwater wetlands and channelization of large streams. For example, the U.S. Fish and Wildlife Service reports that drainage in Delaware has directly or indirectly caused 82% of the loss of freshwater wetlands (a decline of 31,200 acres) between 1956 and 1979. Part of the drainage problem stems from debate over what does or does not constitute a freshwater wetland, particularly since an understanding of what land types function ecologically as "wetlands" was broadened in the 1970s.

One of the most disturbing aspects of drainage projects from an environmental viewpoint is the mechanical channelization of certain types of streams. There is a body of scientific and technical literature indicating that stream channelization may adversely affect levels of dissolved oxygen and turbidity, nutrient levels, sediment flow, surface and groundwater hydrology, and riparian and aquatic biota along a watercourse. While some of these impacts are short-lived, many can be chronic detriments, however, better channel design, installation and maintenance procedures can avoid or minimize some of the environmental detriments. After drainage channels have been installed or reexcavated, there are procedures that can be done to lessen environmental impacts. For example, a relatively new concept of water management (controlled drainage) has evolved that can provide flood protection and drainage benefits, minimize the negative impacts to wetlands, and improve water quality. It entails a total watershed system of land and water management involving land treatment practices coupled with structural measures. Finally, substantial enhancement of wildlife habitat plus improvement in water quality and erosion control could be achieved by better use and management of ditch-edge vegetative

buffer strips. The innovative water management concept of controlled drainage has been tested in other states, principally North Carolina and has shown to produce the following results:

1. Agriculture will benefit from improved water supply and water conservation. (Roughly a 20-30% increase in production can be expected.)
2. As much as 35% reduction in nitrate levels in surface waters can be achieved.
3. Fish and wildlife values can be enhanced with the increased water storage in channels and wetland areas.
4. Wetland values should also be increased reducing drought stress and improving the water regime in these areas.

The Soil Conservation Service and the conservation districts in Delaware are installing water control structures to test this technology. Delaware State College and others plan to monitor water quality where these structures are built. This approach holds great promise in Delaware as a means to resolve a historically heated and controversial issue.

#### RECOMMENDATIONS:

- RECOMMENDATION 1. INCREASE ENVIRONMENTAL PROTECTION AND CONSERVATION MEASURES ON AGRICULTURAL LANDS TO HELP ENSURE A QUALITY FUTURE ENVIRONMENT. Actions necessary to carry out this recommendation include but are not limited to the following:
- a. Traditional institutions for agricultural technology are the best means of implementing new conservation initiatives. These include the conservation districts, USDA Agencies, the state Department of Agriculture, the state's land grant colleges and individual farmers working together.
  - b. Conservation districts should continue to expand their involvement in environmental aspects of solid waste management, water quality, water supply, wildlife habitat, forestry, latest technology drainage and land use planning and should:
    1. Promote the use of conservation tillage (e.g. no-till practices).
    2. Increase the voluntary use of integrated pest management practices, reducing or eliminating unnecessary pesticide use, and increase monitoring for possible pesticide contamination problems even when proper application procedures are followed.
    3. Develop a state-level system to quantitatively track pesticide use in Delaware.

4. Increase the voluntary use of nutrient management plans, with a particular goal of not applying more fertilizers than the crops can uptake.
  5. Increase the voluntary use of animal waste management plans, with particular attention given to environmentally-sound disposal or use of poultry manure and dead chickens.
  6. Increase controlled drainage practices that improve water quality and enhance wetlands, fisheries and wildlife habitats.
  7. Increase the voluntary use of erosion control practices to reduce sediment runoff.
  8. Encourage surface water drainage only as needed for maintaining or enhancing already existing cropland; the creation or restoration of drainage ditches that would unjustifiably convert existing wetlands to cropland or building sites should be discouraged.
  9. Increase structural diversity of aquatic habitats (e.g. pools, riffles, undercuts, wetland vegetation interspersions) can be done in part via water control structures.
  10. Avoid or lessen the channelization of perennial streams and those intermittent streams which flow through wetlands.
  11. Increase the use of low-impact channel renovation methods where practical (e.g. "snag and clean"), while decreasing to the extent practical the use of mechanical channelization for channel creation or restoration.
  12. Make more and better use of hedgerows and vegetated buffer strips adjacent to drainage ditches, both to improve water quality prior to farmland runoff and to enhance on-farm wildlife habitat.
- c. The implementation of the Delaware Association of Conservation District's five year plan will help implement this recommendation. Those plans however, appear to need more input from state agencies involved with forestry, wildlife, fisheries, wetlands, water pollution and water supply, in terms of the plans' development, implementation and monitoring.
- d. Conservation district cost share programs should be continued and strengthened.



## ALTERNATIVE AGRICULTURAL ENTERPRISES WITH POSITIVE ENVIRONMENTAL EFFECTS

Declining farm incomes for many Delaware farmers creates increased interest in alternative agricultural enterprises. Since some of these alternative enterprises have positive environmental implications, they are especially worthy of promotion. Farm Forestry in particular deserves consideration since Delaware contains some marginal cropland that may warrant conversion to growing trees. The long-term outlook for lumber and other forest products is favorable. Biomass farming — the production of crops and wood for conversion to energy — also could become an economic alternative.

Working with the University of Delaware, the Department of Agriculture has funded research on new cropping alternatives including dry edible beans, grain sorghum, yellow-flesh potatoes, seedless watermelons, and are looking at the new marketing twists to traditional crops such as packaging size B potatoes in three pound bags and marketing them as "Small Wonders."

The DOA has also co-sponsored an alternative agriculture conference in cooperation with Penn State University and has participated with 12 Delaware farmers in an Ag Diversification Conference sponsored by SUCCESSFUL FARMING magazine. The Department is also planning for research into new varieties of watermelon, lupines, and other areas.

The Department also has many other programs designed to provide production and marketing information to farmers considering alternative agriculture enterprises with positive environmental impacts.

Diversification is highly desirable but is not without problems. Diversifying for local markets can make good economic and environmental sense when all pros and cons are recognized and adequately addressed.

### Regenerative Farming

Environmental problems associated with agriculture raise questions about the future desirability of conventional farming systems. How to profitably produce the quality of food demanded by consumers while protecting public health, fish and wildlife, and the land itself is the major challenge facing Delaware farmers. Fortunately, regenerative farming practices are available that maximize the use of biological processes rather than chemical. Some farmers have a long history of regenerative farming. Others have recently begun to practice regenerative farming producing biological nitrogen with cover crops, using integrated pest management, fertilizing with poultry manure, and eliminating or reducing yearly phosphorus and potash applications when justified by soil tests. Yet there is much more that can be done toward a sustainable commercial agriculture.

Regenerative agriculture relies on practices such as selective crop rotations; timely tillage and planting; innovative management of organic wastes and crop residues; biological nitrogen-fixation; use of animal manures, legumes, and green manures; and biological pest control. When necessary, limited amounts of synthetic fertilizers, environmentally safe pesticides, growth regulators, and livestock feed additives are used.

#### RECOMMENDATION

INCREASE PROMOTION OF ALTERNATIVE AGRICULTURAL ENTERPRISES WITH POSITIVE ENVIRONMENTAL IMPACTS SUCH AS THOSE EFFORTS NOW BEING CARRIED OUT BY THE DELAWARE DEPARTMENT OF AGRICULTURE AS WELL AS FARM FORESTRY AND REGENERATIVE FARMING.

This increased promotion should also include efforts to attract a major food processor to Delaware which would provide a local market to handle new farm products.

### FOREST MANAGEMENT

Over the last 33 years, forestlands in Delaware have declined, from about 448,000 acres in 1954 down to 376,000 in 1987, or about a 16% reduction (if one uses the 1957 forestland base of 388,000 acres, then the decline is only 4% over the past 30 years). Thus, while some forestland conversions have occurred, the base remains fairly constant. More important than the decrease in forestlands are the changes in timber type that have occurred.

The 1957 survey of timber resources showed 199,000 acres of loblolly pine, while the 1987 survey documented only 79,000 acres. Although there have been other changes in timber types throughout the state, none has been as dramatic as the loblolly pine.

Another trend that has statewide significance is the increase of wetter-forest tree species such as red maple, black gum and sweetgum at the expense of drier-forest tree species. These wetter tree species are considered by foresters and forest industries as weed species and undesirable for forest products. In conjunction with this increase, a decrease in white oak, red oak, yellow-poplar and hickories has occurred. These drier-forest hardwoods are the most desirable to grow for forest products and wildlife food. The reasons for conversion of dry forest to wet forest can include one or more of the following:

1. Past harvesting activities removed the oaks and hickories and have left the gums and maples, therefore eliminating the seed source for natural regeneration of oaks and hickories;
2. Past harvesting practices that do not favor natural regeneration of oaks and hickories have let the gum and maple species become established, thereby suppressing any other tree species;
3. Drought conditions have increased red oak mortality due to water stress and secondary insects and diseases; and
4. Gypsy moth, forest tent caterpillar, oak leaf skeletonizer, and other forest pests combined have reduced the population of the oak and hickory types.

Another possible cause is the destruction of woodland manmade drainage systems during the harvesting of timber which may create a substantially wetter area during the reforestation period.

#### RECOMMENDATION

DELAWARE AGRICULTURE AND FORESTRY POLICY SHOULD PROVIDE FOR THE FOLLOWING ENVIRONMENTAL CONSIDERATIONS:

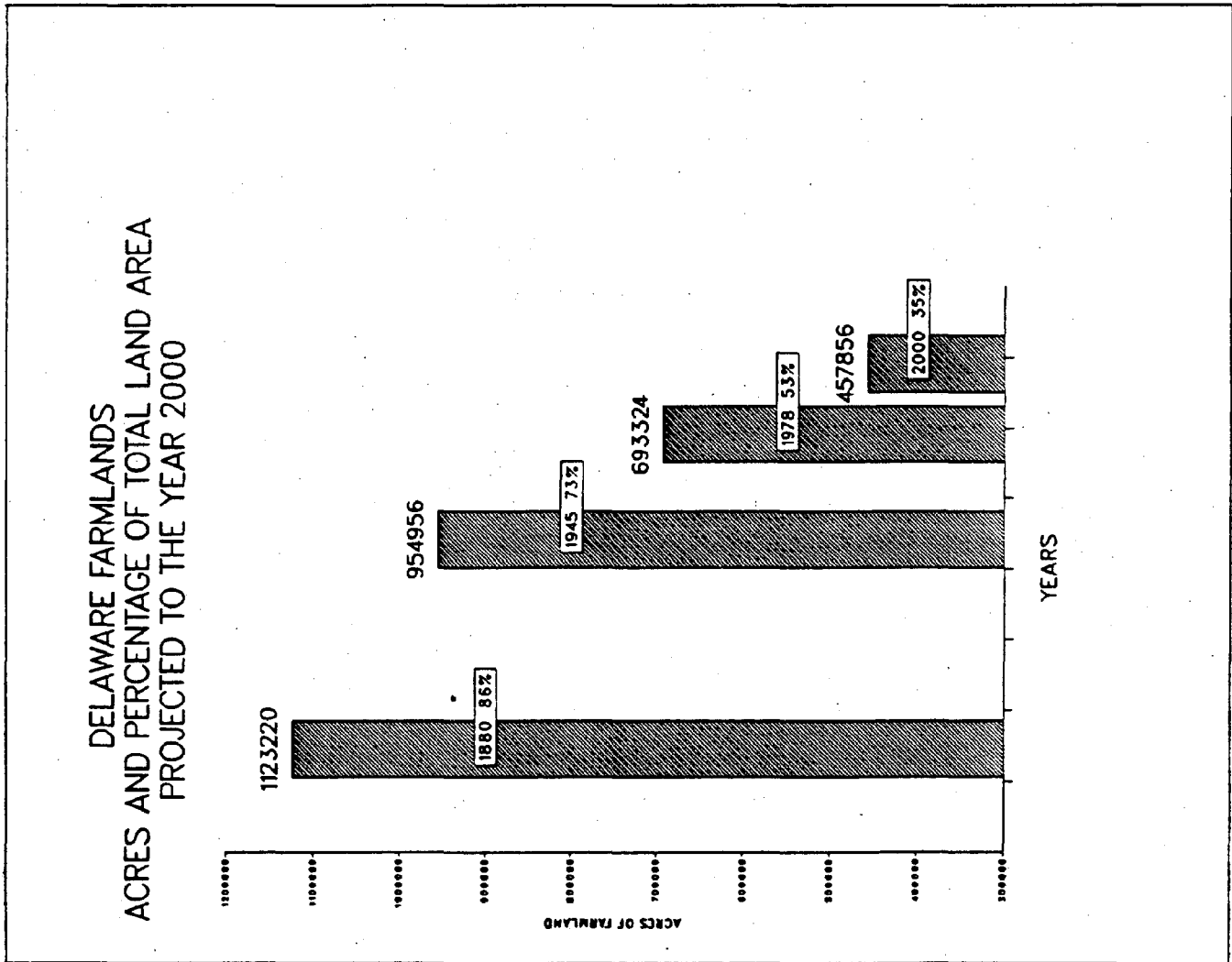
- a. Encourage the production of desirable forest tree species (loblolly pine, oak and hickory).
- b. Replace row crop farming on marginal land with timber management.
- c. New development in forested wetlands should be closely controlled and ultimately eliminated by the year 2000.
- d. Require submission of a reforestation plan and a drainage ditch operations and maintenance plan (if applicable) for approval by the Delaware Department of Agriculture's forestry section prior to timber harvesting.
- e. Subject timber harvest operations to the erosion and sediment control requirements established in the state's Erosion and Sediment Control Act and require that altered drainage patterns be restored.
- f. Encourage use of special considerations when harvesting on slopes greater than 6% and when harvesting up to a stream or ditch (e.g. selective cutting).
- g. Examine desirability of harvesting only during specific seasons to maximize natural reforestation of desirable species.

## PRESERVATION OF AGRICULTURAL LANDS

The importance of agricultural lands to Delaware's environment and economy suggest that preservation of farm (and forest) lands be made a priority. Farmland preservation must also be a component of a state comprehensive open space program recommended elsewhere in this report. The use of land for agriculture can rarely compete economically with commercial and residential land uses and can be incompatible with surrounding land uses due to the need for large undivided tracts of land, dedicated water resources, and the activities associated with agriculture (including livestock and manure, herbicide and pesticide application, etc.). Consequently, there is great pressure in the real estate market to convert agricultural land to other uses, particularly residential. The state's current Agricultural Lands Preservation program, operating under the Agricultural Lands Preservation Act, is non-regulatory and cannot adequately counter market pressures. Figure 26 shows that the amount of farmland in Delaware has significantly decreased in the last century and is expected to further decrease in percent of total land area and actual acreage by the turn of the century.

Farmland and forestland should be protected and preserved as part of a state policy which balances social environmental and economic needs. Farm and forest lands should be well defined but need not be limited to prime agricultural land.

Figure 26



Recognizing that the vitality of Delaware's agricultural industry is directly related to the quality of the state's environment (and vice-versa) and that the market system will ultimately determine how much land stays in active farming, the following recommendations are made:

RECOMMENDATIONS:

RECOMMENDATION 1. THE STATE SHOULD TAKE ACTIONS TO INCREASE THE AVERAGE, NET FARM INCOME FOR DELAWARE FARMS SO THAT SIGNIFICANT NUMBERS OF DELAWARE FARMERS CAN REMAIN IN FARMING. Implementation of this recommendation will help preserve farmland at low cost, provide economically beneficial use of land, and enhance the social and physical environment of the state.

Such actions should include:

- a. Assistance to farmers in commodity diversification.
- b. Assist farmers in reaching export markets.
- c. Strengthen in state and domestic markets.
- d. Provide financial management assistance to farmers.
- e. Increase economic support of those sectors that support, process and distribute agricultural products in Delaware.

RECOMMENDATION 2. THE STATE SHOULD CONSIDER ESTABLISHING AGRICULTURAL DISTRICTS within which farm and forest landowners could voluntarily agree to restrict the use of their properties to certain agricultural and forestry uses for a specified number of years. In return state and local governments would be committed to policies that favor the continuation of agricultural uses. Other agricultural preservation techniques, some of which would be facilitated by the creation of agricultural districts and which may merit consideration include:

Transfer of Development Rights  
Purchase of Development Rights  
Impact Fees & Special Tax/Service Districts  
General Growth Management Policies

In addition, Delaware's Land Evaluation and Site Assessment Program (LESA) should be used to identify Delaware's low, medium and high quality farm and forest land.

# PROTECTING OUR HISTORIC AND PREHISTORIC CULTURAL RESOURCES

## INTRODUCTION

Historic and prehistoric cultural resources are nonrenewable pages from history and prehistory that once destroyed can never be recovered. For more than 12,000 years prior to the arrival of European colonists, the ancestors of the Lenni Lenape and Nanticoke Indians, gave rise to a long series of cultures. Archaeological sites from both prehistoric and early historic periods lie in quiet testimony to the people and cultures who helped shape the state. From the eighteenth century on, many historic sites, buildings, objects and structures remain to form the cultural landscape we see today, each reflecting the values and technology of its time. Yet, the significant historic resources of the state are a relatively thin mantle over the landscape for two reasons. First, for most of its prehistory & history, Delaware's population settled at low densities. Second, Delaware has gained more than half its current population since 1940. Consequently, the historic and prehistoric resources of the state are relatively few in number and are increasingly threatened by modern development.

These cultural resources are more than by-products of our past; they have value today and will have increased value in the future. Much of Delaware's attractiveness is derived from its historic setting where the events and people of prehistory and history are interpreted through the sites, buildings and historic districts that remain. In the State operated museums and historic sites alone, 130,000 people annually visit to learn of Delaware's history and prehistory. Educational value and enjoyment go hand-in-hand. Major attractions for tourism include well-preserved historic districts such as Dover, New Castle and Odessa, as well as sites like Eleutherian Mills/Hagley and Winterthur.

Historic properties can also be a key to economic development and revitalization. Since 1981 the federal investment tax credit program for the rehabilitation of properties listed in the National Register of Historic Places has stimulated the private sector to invest nearly \$40 million in certified rehabilitation (See Figure 27). Economic benefits include increased trades employment and an increased local tax base by returning underused buildings to modern uses.

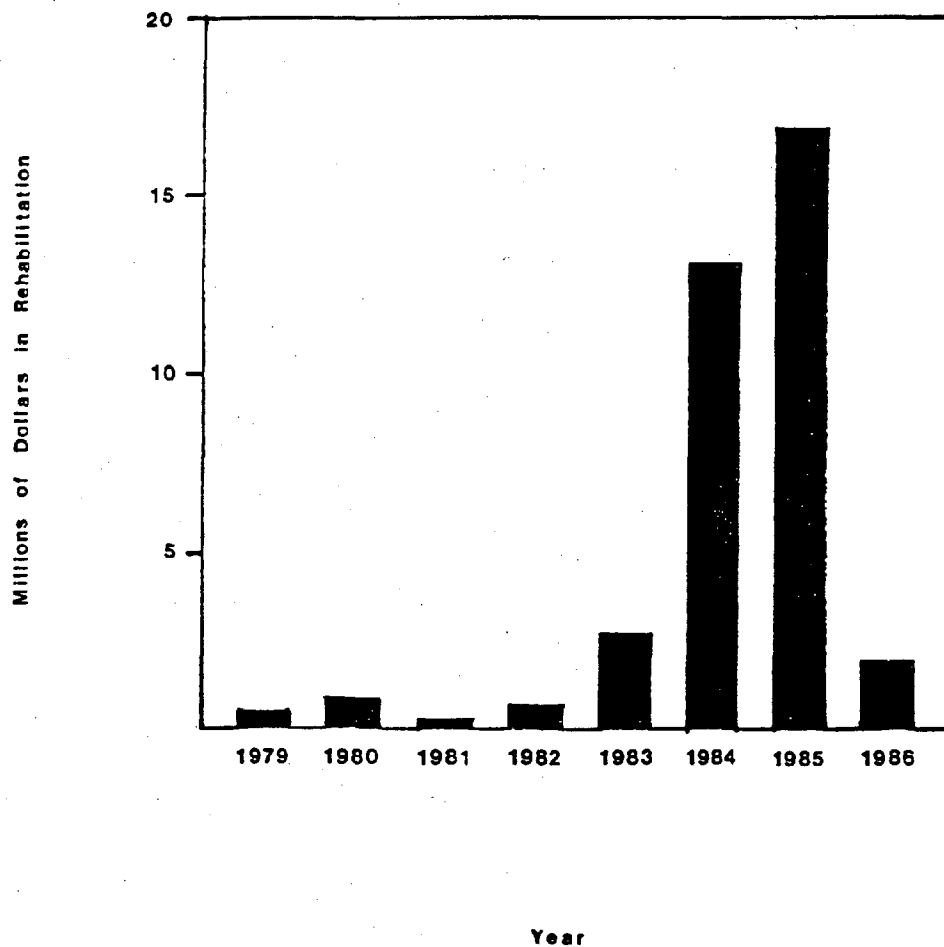
## KEY HISTORIC RESOURCE PROTECTION ISSUES

Historic resources are threatened by two related forces: (1) destruction through development, and (2) lack of public appreciation for their value as a cultural inheritance and an economic asset. Individual historic sites are threatened by neglect, demolition, insensitive rehabilitation and, in the case of archaeological sites, destruction through ground disturbance. Often times the character of these sites is undermined by incompatible development.

Preserving all of Delaware's historic resources is not feasible nor necessarily desirable in the face of needs for good housing and services for a growing population. The question is often asked, "When have we saved enough of Delaware's historic resources?" The phrase "saved enough" must be considered in a certain context. Historic structures, buildings and districts are an integral

Figure 27

**FIGURE 2: DELAWARE HISTORIC PROPERTY REHABILITATION  
UNDER THE FEDERAL INVESTMENT TAX  
CREDIT PROGRAM**



Source: Division of Historical and Cultural Affairs

part of the cultural and natural landscape of the state. They help define the character of Delaware by exhibiting man's interaction in agriculture, industry and commerce with the state's natural environment. In this context, the question then becomes, when have we saved enough of Delaware's historic character in countryside, town or city? The answer lies in an evaluation process. Some areas and buildings exhibit this historic character and linkage with the past more clearly than others. The significance of these sites is indicated by their listing in the National Register of Historic Places. Today, 24 percent (6832 properties) of the total number of historic properties inventoried in the state are listed in the national register. The process of identifying these significant properties is continuing. Figure 28 shows the distribution statewide of national register listings.

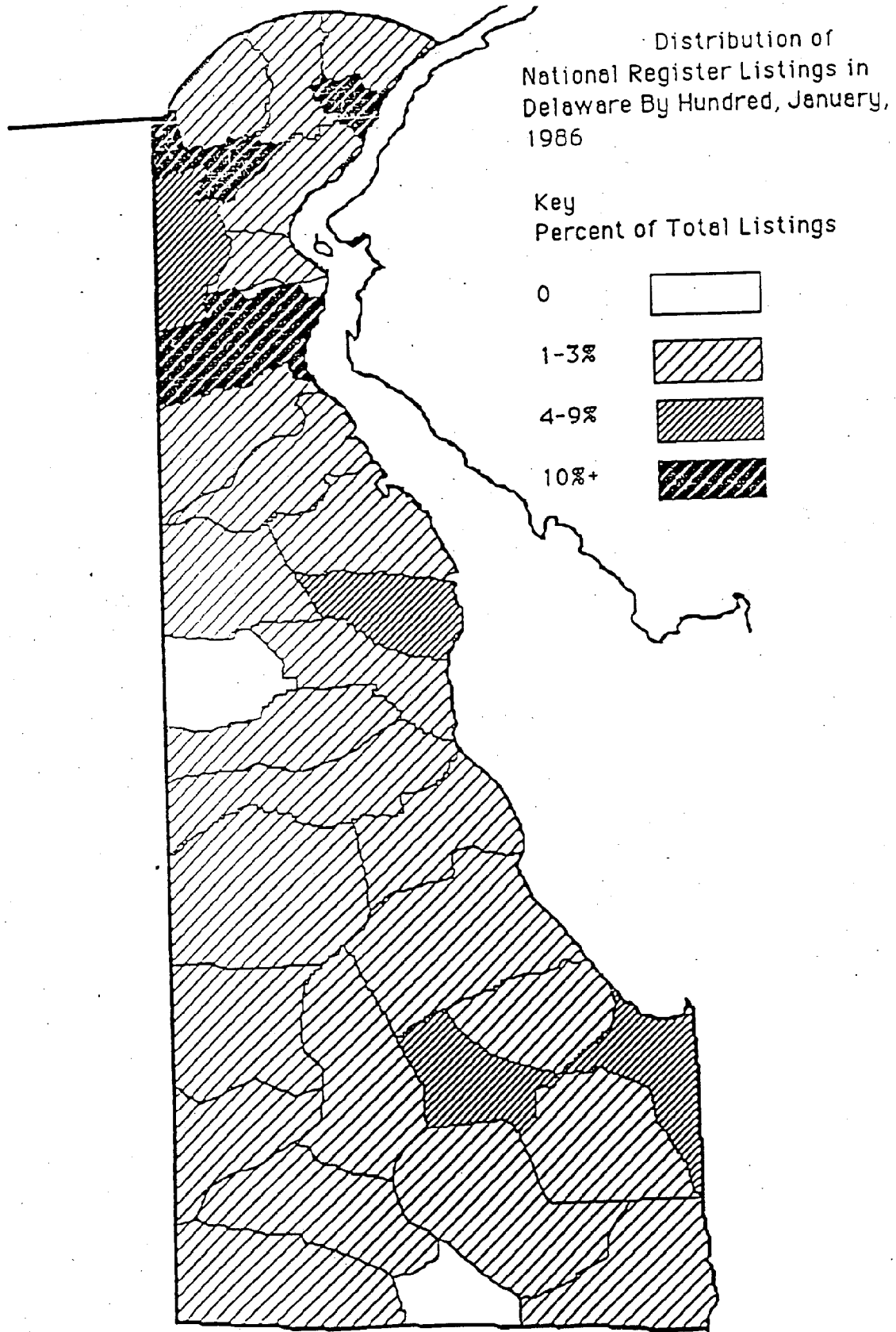
The State Bureau of Archaeology and Historic Preservation has conducted an historic property inventory since 1977. At the present time the inventory, representing all buildings and structures that pre-date 1945, is approximately 95% complete with 28,387 properties on record. The loss rate of historic properties varies throughout the state but has generally been accelerating since 1940. The Delaware Statewide Comprehensive Historic Preservation Plan uses U.S. Census data on "dwelling units" or "housing units" in pre-1940 structures to develop a measure of historic property loss. A crude projection of continued rate of loss can be calculated by taking the average rate of loss for the three decades from 1950 - 1980 (13.8%) and apply it to the 1980's and 1990's (Figure 4). Applying that rate to the 1980's, approximately 6,600 housing units will be lost during that decade; an additional 5,700 will disappear during the 1990's. Thus by the year 2,000, another 12,300 housing units would be lost from Delaware's pre-1940 housing stock. The combined loss of pre-1940 housing units for the second half of the twentieth century (actual and projected) is 40,217 units; 50 percent of the units standing in 1950. With approximately 24 percent of the pre-1940 housing stock listed in the national register, the state faces the loss of 3,406 significant historic resources by the year 2,000. Figure 29 shows the number of housing units in pre-1940 structures by county from 1950 to 1980.

Archaeological sites are generally more significant for the information they contain about the past than for their contribution to the cultural landscape of the state today. Therefore, their preservation in place is not as critical to the state's cultural landscape. However, a sample of all kinds of archaeological sites from different periods and in different environmental zones should be conserved in-place for future study.

Archaeological sites, by their very nature, are difficult to locate. At the present time 2084 archaeological sites have been recorded in Delaware representing prehistoric and early historic periods. This represents an estimated 15 percent of the 15,630 sites which once existed or remain on the landscape. The rate of loss is equally difficult to project. One means of estimating loss is to estimate the land area that will be subject to new development. Estimates provided by the University of Delaware, College of Urban Affairs and Public Policy, indicate that in New Castle County alone, 54,000 gross acres of new development will occur between 1987 and 2000. Construction associated with that development would mean the loss of 810 sites or 7.5 percent of the total sites potentially available for study in the county. If an estimated additional 15,000 acres of development in Kent and Sussex Counties combined is included, then the total statewide site loss would be 1,035 sites or nine percent of the total number of sites remaining.



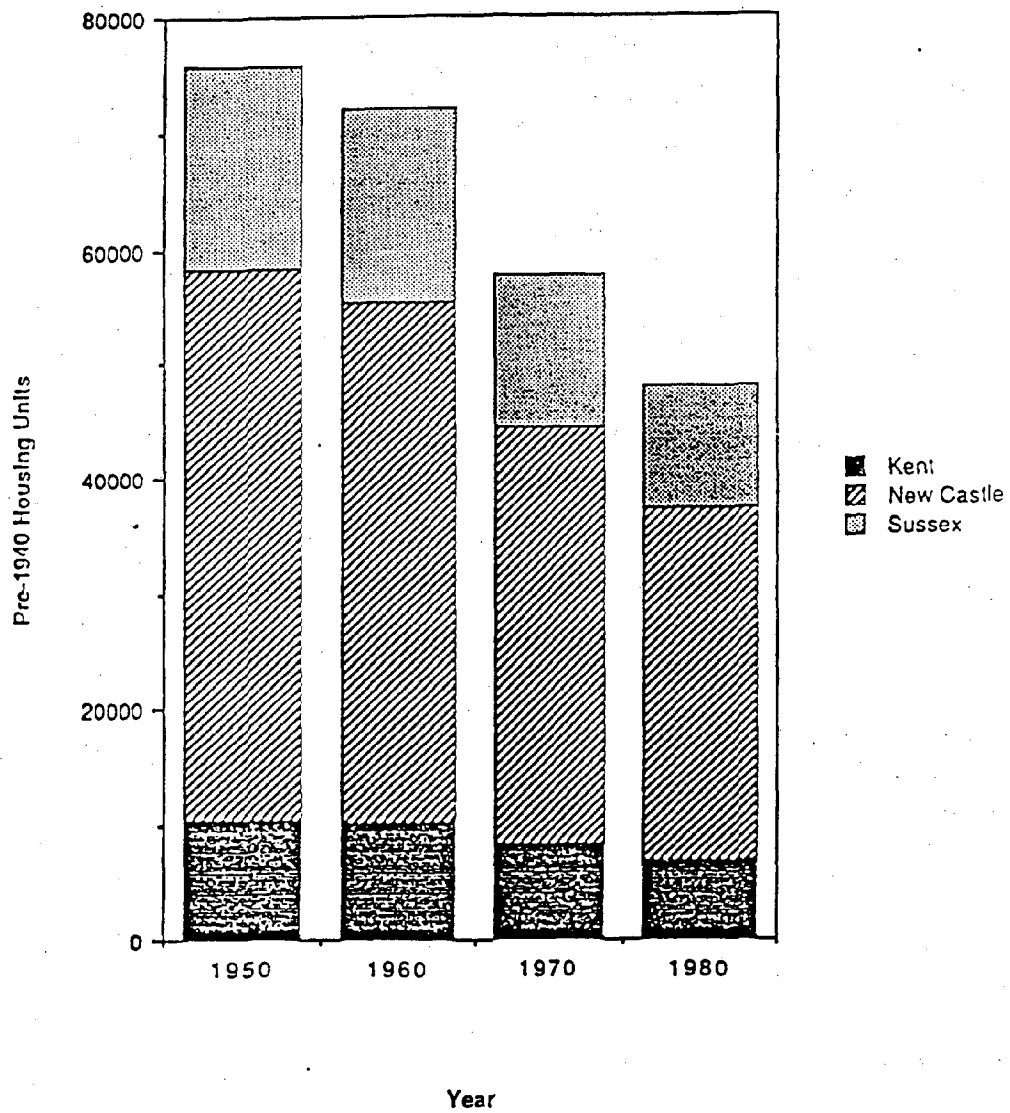
Figure 28



Source: Division of Historical and Cultural Affairs

Figure 29

Housing Units in Pre-1940 Structures  
By County, 1950-1980



Source: Division of Historical and Cultural Affairs

The loss rates for historic and archaeological resources are based on statewide averages. Therefore, in some areas of the state the loss rate is very high while in other areas it is low. The greatest threats are occurring in rapidly developing areas such as the Atlantic coastal area, the greater Dover area and in the Newark-Wilmington growth corridor. The loss rate is further compounded by the fact that these areas also have some of the highest site densities in the state. In these locations, losses of archaeological sites, are as high as two percent per year so that potentially all significant archaeological sites in the high growth areas could be lost within 50 years. In many instances, sites in these areas represent the only examples of certain site types and time periods. It is clear that in some areas of the state, historic and archaeological sites are especially threatened; loss rates are high and, in many cases, resources are unique. In these areas, efforts by both the public and private sectors to record and preserve significant properties and sites must be given priority.

The protection of historic and archaeological sites is a complex problem that state government cannot accomplish on its own. All levels of government and the private sector must participate. Nevertheless, the state must take a leadership role in establishing a statewide historic preservation program. This leadership must include a central coordinating function, the development of incentive programs and the implementation of regulatory oversight on state governmental actions.

#### RECOMMENDATIONS

- RECOMMENDATION 1. IMPROVE COORDINATION OF ARCHAEOLOGICAL AND HISTORIC PRESERVATION PROGRAMS BY DESIGNATING THE BUREAU OF ARCHAEOLOGY AND HISTORIC PRESERVATION THE LEAD AGENCY IN CARRYING OUT DELAWARE'S HISTORIC PRESERVATION PROGRAM AND PROVIDE FULL STATE SUPPORT FOR THE BUREAU. Functions of the bureau would be to:
- a. Provide statewide plans, policies and standards.
  - b. Provide point-of-contact for state and local land use coordinators on historic issues.
  - c. Provide information for use in automated planning data systems.
  - d. Provide central program administration of state programs and oversight of other programs.
  - e. Participate in State Development Advisory Service.

At the present time Delaware does not have a state mandated preservation program. The general fund supplies match for a grant from the Department of the Interior to carry out largely federal functions. To provide a leadership role in historic preservation the bureau must have the capability to establish and administer state priorities and programs and not be totally dependent on federal priorities and funding schedules.

RECOMMENDATION 2. STRENGTHEN STATE STEWARDSHIP OF SIGNIFICANT HISTORIC PROPERTIES BY PROVIDING PROTECTION FOR STATE OWNED OR CONTROLLED PROPERTIES.

Means to implement this recommendation are:

- a. Develop legislation to require all state agencies who own, control or may affect significant historic properties or archaeological sites to obtain the comments of the Bureau of Archaeology and Historic Preservation prior to implementing any development activity.

State government should set an example of responsible stewardship of state owned historic properties and sites. Insensitive rehabilitation and the application of inappropriate construction techniques have damaged significant historic properties in state ownership. In addition, valuable archaeological sites have been destroyed by state sponsored construction projects. Bureau historians, archaeologists, architectural historians, and architects should review projects effecting properties listed in the National Register of Historic Places.

- b. Amend the State Antiquity Act to expand jurisdiction to the protection of significant historic shipwrecks.

At the present time, Delaware law protects archaeological sites on state owned or controlled lands. Historic shipwrecks are not specifically covered and are currently protected only by the subaqueous lands permit and lease system of the DNREC. In the face of increasing efforts to search for and salvage historic shipwrecks the state needs to more explicitly declare its authority over such sites as an important historic resource to insure that the state and public interests are best served.

RECOMMENDATION 3. THE STATE SHOULD PROVIDE LOCAL GOVERNMENTS WITH SUFFICIENT MEANS TO PROTECT HISTORIC AND PREHISTORIC RESOURCES BY:

- a. Requiring historic preservation elements in all local comprehensive development plans.

The real responsibility and legal power to protect historic resources rests at the local level. Without historic preservation elements in local comprehensive plans, however, historic zoning and regulations are not legally enforceable. This would provide local governments with the tools necessary to protect significant historic resources.

Recommendations in the Land Use and the Environment section of this report illustrate ways in which historic preservation objectives can be partly achieved.

- b. Developing state legislation for historic property housing and building codes that are sensitive to the unique architecture of historic buildings.

Applications of modern housing and building codes to historic structures may inadvertently damage significant elements of historic properties. Codes should be developed or existing codes modified to allow for flexible code application when applied to properties listed in the National Register of Historic Places.

RECOMMENDATION 4. PROVIDE INCENTIVES FOR HISTORIC PRESERVATION BY:

- a. Establishing a state matching grants program for the restoration or rehabilitation of properties listed in the National Register of Historic Places and owned by public or private parties.

This provides state incentives for stabilization and rehabilitation and can be a catalyst for growth within existing communities or certain historic (target) areas within those communities.

- b. Exploring the feasibility of state and local tax incentives to encourage rehabilitation of owner occupied and income producing properties listed in the National Register of Historic Places.

Tax incentive programs would provide state and local incentives for stabilizing existing communities and neighborhoods provide the catalyst for this development. This could encourage population density and centralized land use through the rehabilitation of historic properties in existing communities.

RECOMMENDATION 5. ENVIRONMENTAL EDUCATION PROGRAMS SHOULD INCLUDE HISTORIC AND ARCHAEOLOGICAL PRESERVATION COMPONENTS.

Recommendations in the Environmental Education Section of this report provide the means by which this recommendation can be implemented.

# OPEN SPACE AND RECREATION

## INTRODUCTION

No environmental legacy would be complete without an adequate supply of open space for the many environmentally related functions that it provides: air quality filtering, aquifer recharge and protection, habitat for flora and fauna and a location for many forms of active and passive outdoor recreation. Open space comes in many forms such as agricultural lands, marshlands, wildlife sanctuaries, public parks, protected natural areas, lakes and ponds.

Many significant efforts have been made by the state, local governments and concerned environmental groups to protect open space. Agricultural lands preservation legislation was enacted, acres of parkland dedicated and large tracts of sensitive lands purchased to protect critical landscapes. Unfortunately, however, thousands of acres of open space have also been lost due to a lack of coordination, underfunding and conflicting priorities. For example, the interests of hunters, water managers, agri-business, recreation enthusiasts and conservationists are often in conflict — yet all support the need for open space.

Some components of open space such as marshlands, lakes and ponds, critical natural areas and agricultural lands have been discussed in various contexts throughout this report. This section is concerned with open space principally as a resource for active and passive outdoor recreation and conservation.

## AVAILABILITY OF RESOURCES

Delaware's statewide park and conservation area network not only play an important role in providing open space for recreation but also protect distinctive scenic, natural, cultural, and historic resources. Delaware has over 10,000 acres of state park lands where natural and historic landscapes are conserved along with space for active and passive recreation.

6,700 acres of county, small town and municipal park lands are available statewide for recreation. In this system there are intensively developed parks with ballfields, basketball courts, pools and even golf courses. Some park areas have wide open meadows or dunes and wooded places for passive recreation. Closest to home there are neighborhood and school playgrounds — nearly 350 statewide. Open space areas for recreation have grown from approximately 2,110 acres (at 182 sites) in 1965 to today's 6,710 acres (at 345 sites). Open space for urban recreation, particularly in Wilmington, has not grown at the same rate as those in other New Castle County locations. Wilmington manages 50 sites on 278 acres. Although the number of softball fields, basketball courts and playgrounds have increased in the last two decades, urban facility needs in Wilmington are still great.

The State Division of Fish and Wildlife manages 33,000 acres of land and water including wildlife areas, fishing and boating access points and freshwater ponds. Large parcels are found statewide particularly along the Delaware River and Bay coastline and the inland bays. Ponds dot the landscape throughout the state.

State Forests provide conservation and recreation benefits, provide habitat for wildlife and a place for active and passive recreation. Nearly 16,000 acres of land are held by the U. S. Fish and Wildlife Service. These lands are managed for wildlife and represent extensive tracts of open space.

Outdoor recreation open space in Delaware has grown considerably since 1966. The Federal Land and Water Conservation Fund Act of 1965 has provided the State with \$28.5 million for outdoor recreation needs. These appropriations have been matched with state and local monies and private donations to acquire and develop land for parks and conservation areas. While this program has been effective present day recreation and conservation needs remain unmet. Future open space needs for recreation will be difficult to meet.

## RESOURCES FOR THE FUTURE

The 1984 Delaware Outdoors, the statewide comprehensive outdoor recreation plan, indicates statewide facility and resource-base deficits at least through the year 2000. While these deficits should be met by both the public and private sectors, citizens traditionally look to government to fulfill traditional park and recreation needs.

In order to meet the public's recreation demand for facilities many more land areas around the state must be acquired to provide close to home recreation and to protect valuable or disappearing natural landscapes. A range of sites from vest pocket parks in towns, to state parks and nature preserves, and wildlife areas are needed.

Greenways is a means to tie recreation and conservation areas together, the result being a contiguous, relatively large, uninterrupted area where recreation, wildlife protection and other forms of resource conservation can co-exist. Greenways are not new. There is a nationwide trend to establish greenways which may be in public or in private ownership.

Rivers and streams are natural corridors, offering trails on the shores and boating or canoeing in mid-stream. They can link existing open areas in state parks, forests, wildlife areas and ponds, the entire network winding through both rural and urban areas. Abandoned rail lines under some circumstances could become hiking, biking and bridle paths. Utility rights-of-way also can provide open space not only for hikers and bicyclists but also for wildlife.

As recreation trends change, Americans place increased demands on recreation lands and natural resources. As these resources become heavily used, conflicts usually arise between competing user groups and the resources. In addition, heavily used resources may also experience problems related to vandalism, public safety, liability, sanitation, litter control and other environmental impacts such as: all terrain vehicle use, heavy (licensed) beach vehicle and boating use and general overuse of facilities.

## KEY OPEN SPACE ISSUES

### Acquisition and Development

The preservation of open space will be increasingly important as Delaware continues to develop and its population increases. In-holdings and lands adjacent to existing park properties are needed to protect sensitive resources. Municipal governments should designate areas within or near their boundaries to

meet close-to-home recreation needs as well as to protect important examples of our state's natural heritage. Integrated approaches to recreation and wildlife management such as greenways should be encouraged.

Not all open space suitable for recreation fall under the traditional responsibility of public or private land management agencies. The public and private sectors should cooperate to insure availability and protection of some areas. This may require new approaches and or organizations such as non-profit land trusts.

## **Funding**

Stable funding is needed to ensure sufficient open space. The Delaware Land and Water Conservation Trust Fund, established by the General Assembly in 1985 is used for planning, acquisition, and development of public parks, recreation facilities and conservation areas. The trust fund supplements and, if necessary, replaces declining federal funds. Matching grants can be given to state and local agencies using only the trust's interest with the principle remaining intact. As of November 1, 1987 the trust fund principle stands at \$3.63 million. The interest to date is approximately \$150,000.

## **Conflicts of Resource Use vs. Protection**

The conflicts of resource use versus protection are getting worse. People recreating often compete with wildlife, fisheries, and other uses for the same sites. Some cooperative arrangements work while others don't. While land managing agencies are confronted with the responsibility to promote a balance of use and resource protection, increased attention should be given to public policy that promotes the wisest use of Delaware's sensitive recreation areas. As public resources become heavily used, the public must be involved in setting priorities for those uses.

Before actions necessary to preserve adequate open space for the future can be taken, there will be a need to evaluate the adequacy of existing parks and wildlife areas. In the past, Delaware has acquired lands for fish and wildlife, parks and forestry through purchase, donation and federal transfer. Figures 30 through 33 shows these land acquisition trends.

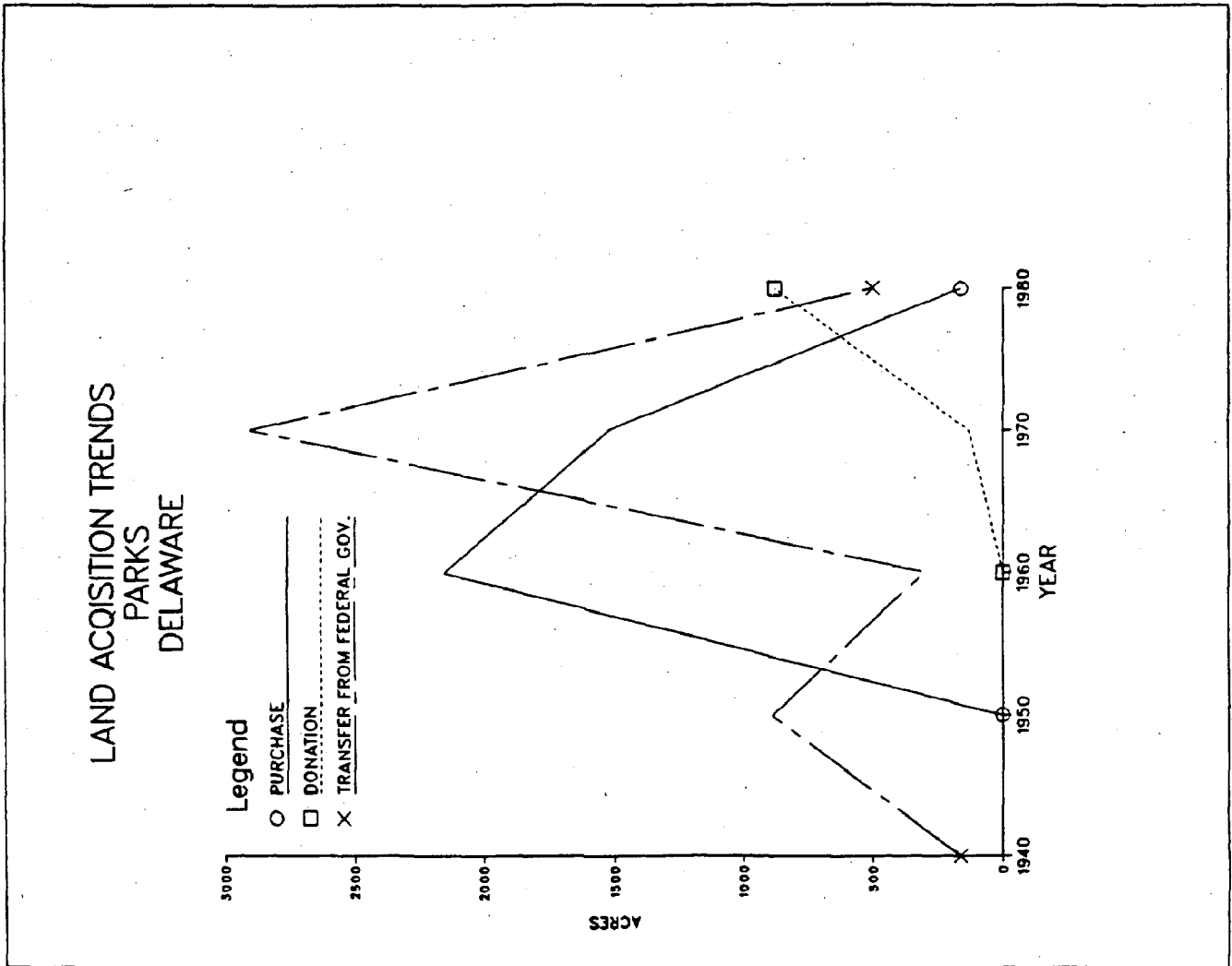
## **RECOMMENDATIONS**

### **RECOMMENDATION 1. THE STATE SHOULD ESTABLISH A COMPREHENSIVE LANDS ACQUISITION PROGRAM.**

The program should refine criteria to identify lands for protective acquisition that balances the values of different groups and purposes. Criteria should address why protective acquisition is needed, how much land is needed, and the most effective means of ensuring protection. The program should incorporate a variety of protective methods such as tax incentives, zoning restrictions, conservation easements and voluntary associations. However, outright land acquisition is recognized as the best means of ensuring long-term protection. A strategy or process for administering these criteria needs to be developed to provide guidance for capital budgeting and program planning.

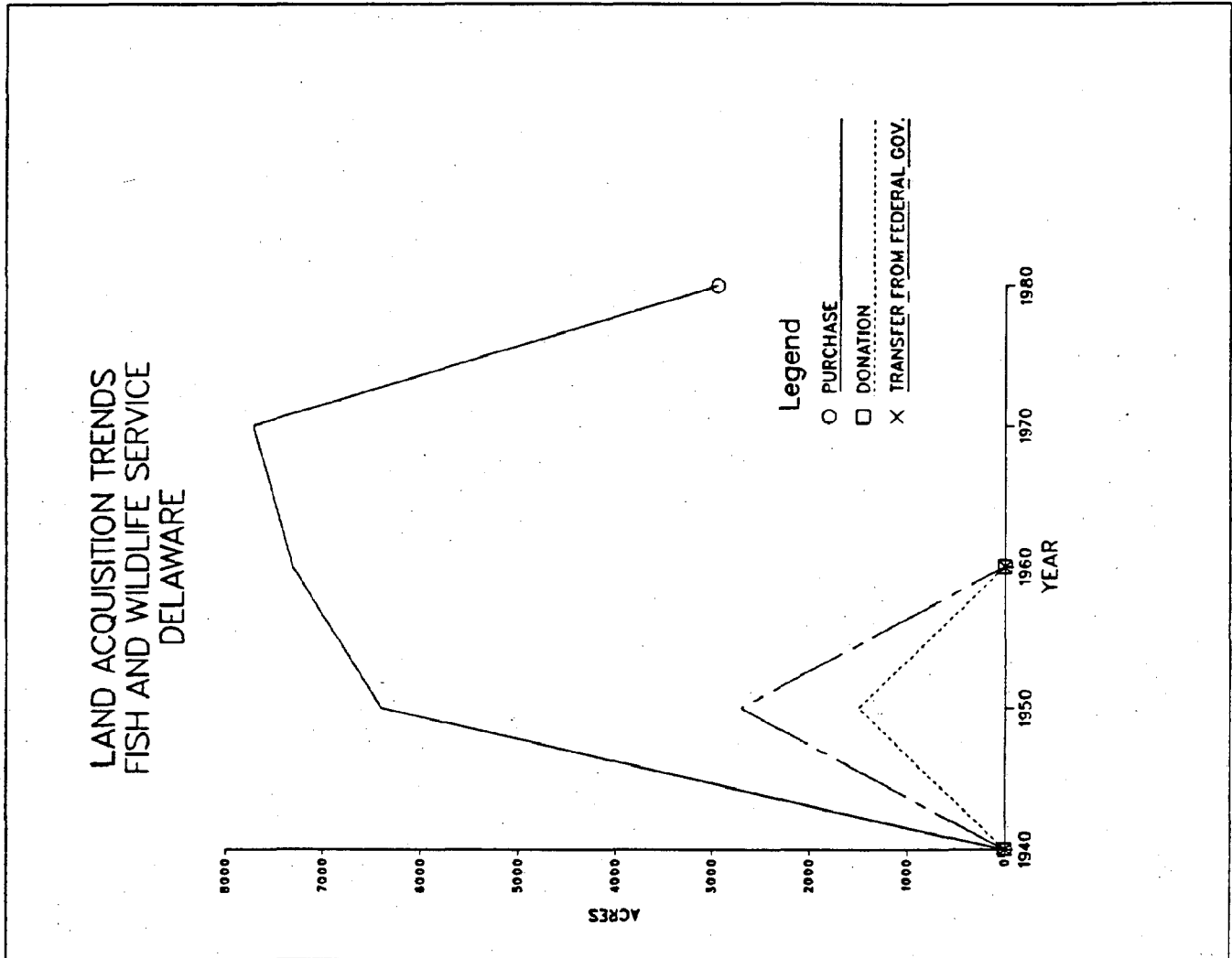


Figure 30



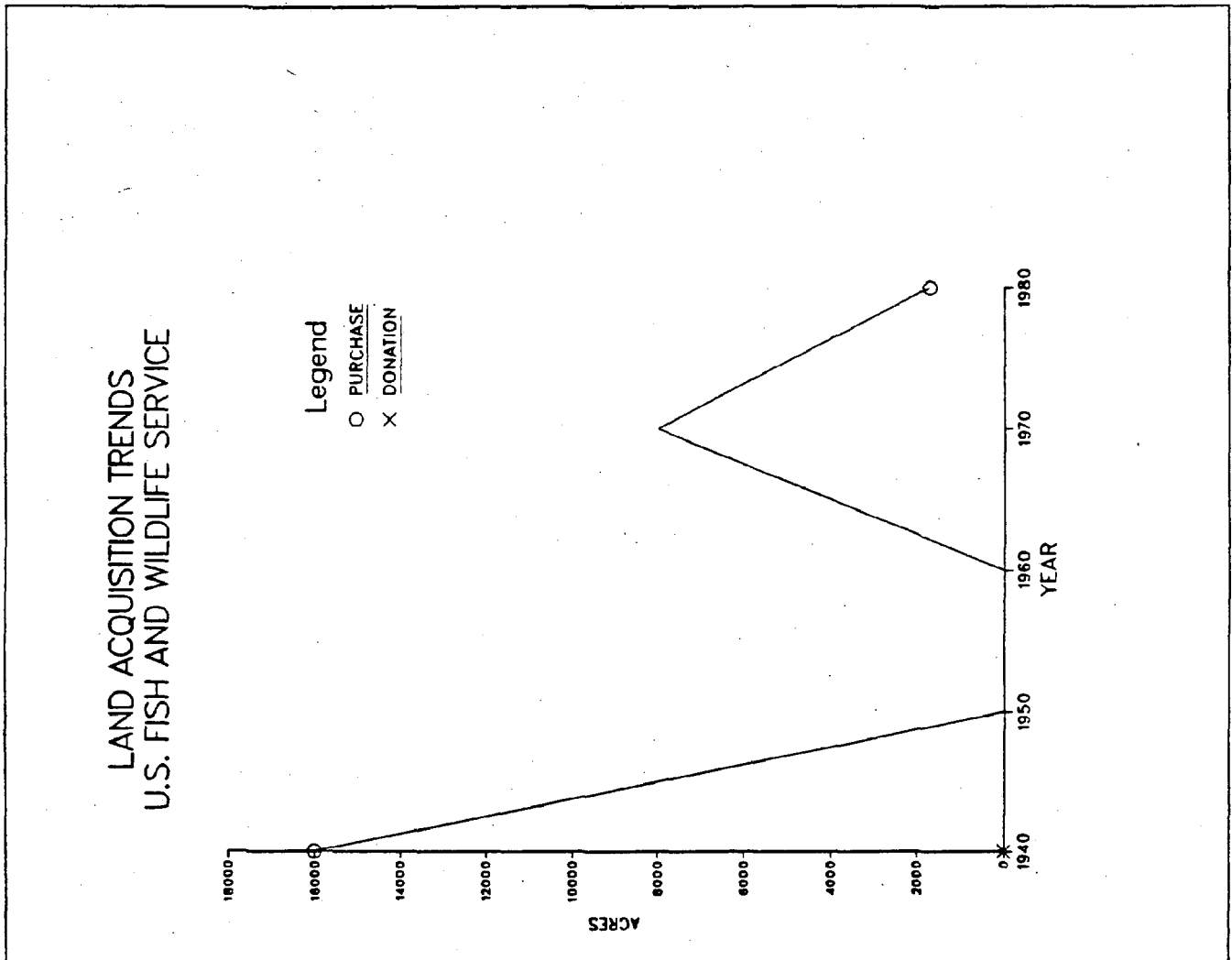
Source: Department of Natural Resources and Environmental Control

Figure 31



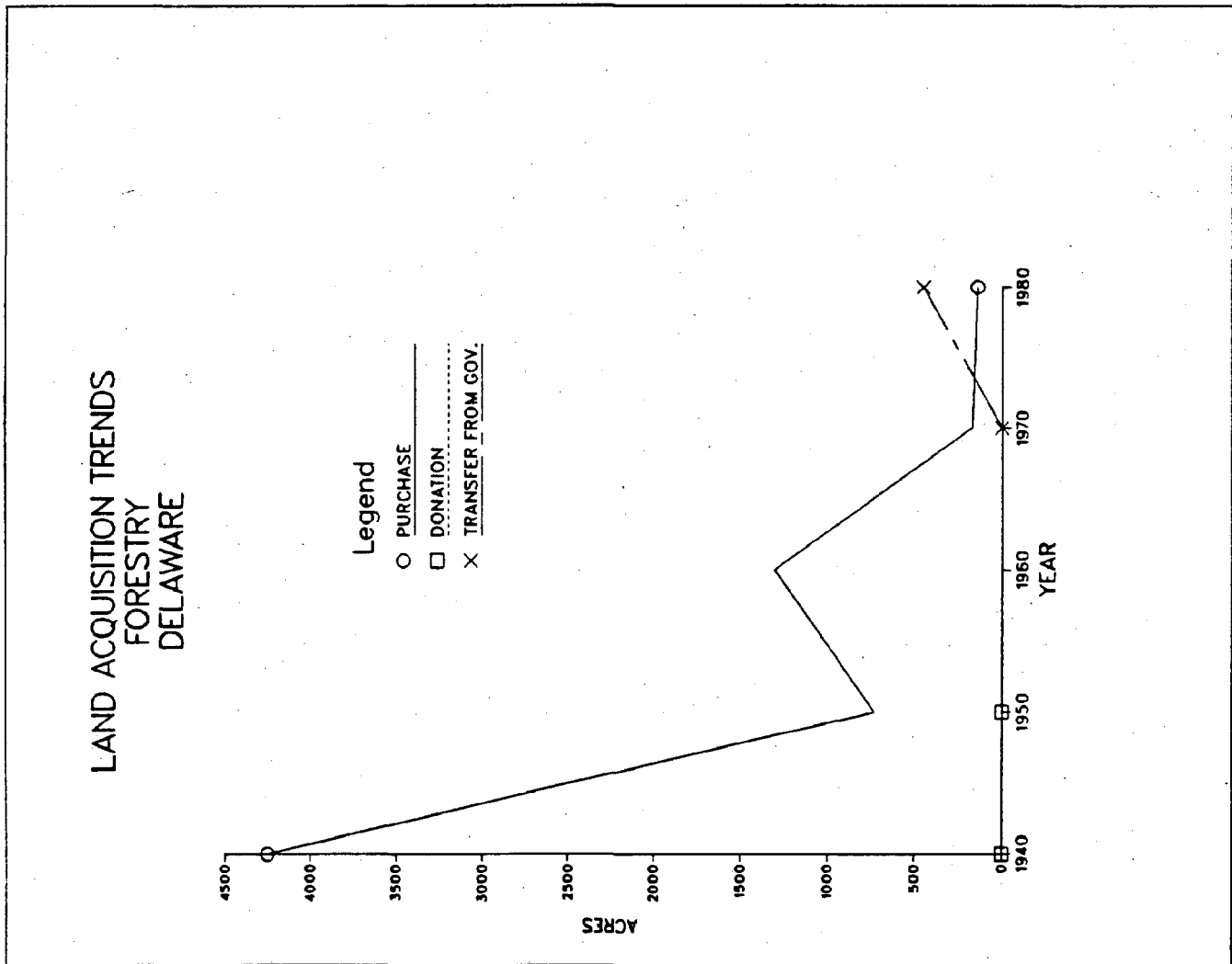
Source: Department of Natural Resources and Environmental Control

Figure 32



Source: Department of Natural Resources and Environmental Control

Figure 33



Source: Department of Natural Resources and Environmental Control

RECOMMENDATION 2. THE DELAWARE LAND AND WATER CONSERVATION TRUST FUND SHOULD BE BROUGHT TO A SUFFICIENT LEVEL AS SOON AS POSSIBLE TO PROVIDE FOR THE MOST CRITICAL LAND ACQUISITION AND OUTDOOR RECREATION AND DEVELOPMENT NEEDS.

Government and private contributions to the Trust Fund should be encouraged. After the initial goal is met further contributions will be determined by expressed demand for assistance, inflation, rate of return on investment, availability of federal funds, and the recreation and open space needs analysis of the Statewide Comprehensive Outdoor Recreation Plan.

RECOMMENDATION 3. PUBLIC AND PRIVATE AGENCIES SHOULD ADOPT THE GREENWAY CONCEPT AND WORK TOGETHER TO PUT GREENWAYS IN PLACE FOR THE BENEFIT OF ALL RECREATION, CONSERVATION AND PRESERVATION INTERESTS.

RECOMMENDATION 4. TAX INCENTIVES SHOULD BE AFFORDED THOSE WHO VOLUNTARILY DONATE LANDS TO BE PRESERVED IN OPEN SPACE.

RECOMMENDATION 5. TO PROTECT THE NATURAL RESOURCES AND THE RIGHTS OF PRIVATE PROPERTY OWNERS, ALL TERRAIN AND OFFROAD VEHICLE USE SHOULD BE RESTRICTED THROUGH LICENSING AND REGULATION.

Organizations representing ATV's and ORV's should be encouraged to provide special areas for specialized vehicle use through private action.

RECOMMENDATION 6. THE STATE SHOULD ASSESS THE ENVIRONMENTAL IMPACTS OF RECREATIONAL BOATING.

Policy should be established to prevent over-use of facilities and user group conflicts. The use of dry-storage facilities should be investigated as an alternative to increased marina development. Consideration should be given to training and licensing boat operators, especially youth.

## **PART IV**

# **CROSS CUTTING ISSUES**

# LAND USE AND THE ENVIRONMENT

## INTRODUCTION

Under the Delaware Constitution state government has ultimate responsibility for the protection of natural resources. The powers of the county and municipal governments are largely subordinate and derived from the state. While the courts adjudicate disputes between individuals and government, the Governor is responsible for establishing policy to manage the state's environmental resources.

Gradually, but very persistently, steps taken to manage the state's environmental resources have become more frequent since the 1950's. There are many reasons for this. The state's population has doubled; access to the Delaware Bay and shore areas has greatly improved bringing thousands of visitors and summer homeowners to those regions. Farming, home building and manufacturing have also continued to change and expand. As this report has repeatedly pointed out, these activities, taken in combination, have placed ever increasing burdens on the carrying capacity of the natural environment.

Protecting and managing our natural resources, maintaining a desirable "community character" and providing roads, sewers and other infrastructure in a manner that safeguards environmental quality, are principles that should guide land use policy making and regulation in Delaware. Recommendations found throughout this report reflect these principles and illustrate the wide range of actions that affect our use of land.

In the broadest sense, a land use section of this report is an anomaly since each section recommends actions that will alter man's use of land, and therefore, modify his impact on Delaware's environment. As shown in Part IV, however, the key to environmentally sound land use management in the long term is a policy that considers singular actions as parts of a whole (i.e. an ecosystem). A slightly different but equally important need is to recognize the institutional framework within which land use decision-making occurs and to devise a system capable of formulating policy that will prevent environmental degradation rather than react to it.

Throughout this report, recommendations have been made that will require implementation at municipal, county state and even national levels. Clearly pointing out that land use planning is a shared governmental responsibility. In looking to the future, each of these partners will have to improve their ability to shoulder their responsibilities in land use management. Greater clarification of those responsibilities, along with the need to better coordinate policy and ensure consistency in regulatory practices, is needed.

## THE KEY LAND USE ISSUES

### The Need to Strengthen the Local Land Use Planning/Management Process

Delaware's Constitution grants the General Assembly discretionary authority to delegate zoning responsibility to municipalities and counties.

The State has chosen to share with local governments responsibility for zoning, land use planning and regulation. Primary responsibility for developing land use plans, acting on rezoning and subdivision requests, and issuing building permits resides with local governments. For the partnership to work in the best interests of Delaware's environment, local comprehensive plans must reflect state environmental policies. The state must also retain environmental controls that override local land use authority. Transportation, water supply management, wetlands protection, water and air quality control, beach preservation, coastal zone, flood plain management, and wildlife protection, are such state responsibilities.

At the same time state regulatory actions must support specific provisions of local plans since state funding and permitting requirements influence the location of growth. For example, the state spends its money and directs federal funds for sewer systems, is responsible for almost 100% of the road funds (state and federal) and is examining a state water system financing policy. The state also has permitting responsibility for sewer and water systems. If the state ignores local comprehensive development plans when infrastructure placement decisions are made, local growth policies are abrogated.

#### RECOMMENDATIONS

- RECOMMENDATION 1. LEGISLATION SHOULD BE ENACTED TO REQUIRE THAT ALL DELAWARE MUNICIPALITY AND COUNTY SUBDIVISION REGULATIONS AND DECISIONS CONCERNING INFRASTRUCTURE PLACEMENT BE IN ACCORDANCE WITH AND CONSISTENT WITH THEIR COMPREHENSIVE DEVELOPMENT PLANS.
- RECOMMENDATION 2. LOCAL COMPREHENSIVE DEVELOPMENT PLANS SHOULD BE REVIEWED FOR THEIR CONSISTENCY WITH STATE POLICIES AND STANDARDS AT LEAST EVERY FIVE YEARS AND AMENDED WHERE NECESSARY.
- RECOMMENDATION 3. RIGOROUS STANDARDS SHOULD BE APPLIED TO LAND USE PLAN AMENDMENT PROCESSES. AMENDMENT SHOULD ONLY OCCUR WHERE SUCH POTENTIAL PROJECTS PROVIDE SUBSTANTIAL BENEFITS TO THE COMMUNITY AT LARGE.
- RECOMMENDATION 4. DECISIONS FOR FUNDING INFRASTRUCTURE AND OTHER PURPOSES SHOULD BE CONSISTENT WITH COUNTY AND MUNICIPAL LAND USE PLANS. AS A CONDITION FOR ISSUING ANY STATE PERMIT FOR A PROPOSED DEVELOPMENT PROJECT, THE COUNTY OR MUNICIPALITY MUST MAKE A FINDING THAT THE PROJECT IS CONSISTENT WITH THE JURISDICTION'S LAND USE PLAN AND ZONING AND SUBDIVISION REGULATIONS.

#### **The Need for Increased State Involvement in Land Use Management**

The demise of the state planning office in the mid-1970's marked the beginning of a decentralized approach to planning in Delaware. Under this decentralized approach, various agencies are responsible for the development of planning goals and objectives to accomplish their various missions (i.e., the Department of Natural Resources and Environmental Control assures short and long term environmental protection and conservation goals are met; the Department of Transportation develops long-range transportation plans, and the Department of Agriculture works to achieve farmland preservation goals). In addition, state agencies respond to development requests under consideration by all three



counties as those requests affect agency policies. Discussions contained in this report point up a number of areas where an increased level of state involvement in local land use decision-making is important.

The absence of specific state guidelines or standards for the protection of aquifer recharge areas and unique natural areas, for example, has by default placed the burden of management at the municipal or county level. Dependence on local ordinances will have little effect on the long-term conservation of statewide land resources. Many land use management issues cannot be appropriately regulated at the local level because of the often complex and inter-jurisdictional nature of environmental concerns and the need for long-term solutions. These factors require management systems which cross jurisdiction lines and include strong technical components which can be provided more effectively at the state level.

#### RECOMMENDATIONS

RECOMMENDATION 1. STATE POLICIES AND STANDARDS SHOULD BE DEVELOPED TO ENHANCE ENVIRONMENTALLY SOUND LAND USE MANAGEMENT. LOCAL GOVERNMENTS SHOULD ADOPT THESE STANDARDS AND BE REQUIRED TO INCORPORATE THEM IN THEIR COMPREHENSIVE DEVELOPMENT PLANS.

State policies and standards should be developed for the protection of specific natural resources to include but not limited to:

- \* Surface and groundwaters that provide water for public water supply systems.
- \* Freshwater Wetlands
- \* Floodplains
- \* Major aquifer recharge areas
- \* Unique natural areas

Criteria for policies and standards should be based on the environmental and ecologic characteristics of the land. The absorptive or carrying capacity of the water, land or air must also be recognized. All state policies and standards should be reviewed at least every five years and amended where necessary.

RECOMMENDATION 2. THE STATE SHOULD CONDUCT A COORDINATED REVIEW OF DEVELOPMENT PROJECTS OF "MORE THAN LOCAL SIGNIFICANCE."

Development projects of a certain magnitude can have a wide range of impacts that are felt beyond the local communities in which they are sited. Such projects place additional strains on infrastructure, housing, waste disposal systems and the environment. These projects may also have significant effects on community character, commerce, employment and population.

When a development project has more than local significance, an inter-agency team, with representation from all appropriate state agencies should conduct a review. Criteria for defining more than local significance would be developed by the team in conjunction with local planning officials. Project review made by the inter-agency team would be submitted to the appropriate locality in accordance with its established review process.

## **Improve Coordination of Information**

In the absence of a centralized state approach to planning, a number of ways have been established to achieve some degree of coordination in the review of development proposals. The Land Use Planning Act (LUPA) was designed to solicit the views of a wide range of state agencies on the merits of development proposals under consideration by localities. This Act also offers local governments the opportunity to review and comment on certain state projects.

Two other coordinating mechanisms are the Development Advisory Service (DAS) and the Cabinet Committee on State Planning Issues. DAS, which is staffed by the Department of Natural Resources and Environmental Control, includes representatives from a number of state agencies and serves as a clearinghouse for information regarding regulatory requirements. By arranging a single meeting for the applicant, the DAS identifies all required permits and advises the applicant of other requirements and procedures.

The Cabinet Committee on State Planning Issues is authorized under Chapter 91 of the Delaware Code. The Cabinet Committee, staffed by the Office of State Planning and Coordination, is comprised of the Secretaries of the Departments of Natural Resources and Environmental Control, Transportation, Agriculture, the Director of the Delaware Development Office and such others as the governor may designate. The Cabinet Committee is responsible for considering matters related to the orderly growth and development of the state.

## **Problems of Coordination**

Current means of coordination provide a basic framework for communication and coordination between the various governmental agencies involved in land use planning and decision making. However, these means do not always work in an integrated fashion. Moreover, important gaps exist in certain processes and the powers authorized to carry out the different functions are not fully utilized. For example, the quality and consistency of state comments is variable and the review time allotted to the state by local governments is often inadequate. To improve land use decision-making in the years ahead, communication between state and local agencies must improve and ample time must be afforded for review. In cases where state policy is unclear, someone must be made responsible for gathering sufficient information to clarify the state's position.

### **RECOMMENDATIONS**

#### **RECOMMENDATION 1. ENCOURAGE STATEWIDE USE OF THE DEVELOPMENT ADVISORY SERVICE.**

The Development Advisory Service (DAS) provides an opportunity for private developers to get early advice on the state permits necessary to carry out development projects. At present, DAS is utilized to a great extent by

Sussex and Kent Counties, and to a lesser degree by New Castle County. DAS review of a large scale and multi-permit development proposal greatly benefits developers and serves to reduce permitting problems that may arise in the latter stages of the county approval processes. General standards and guidelines for projects benefiting from DAS review should be developed by DNREC and made available to local governments. In turn, local governments should inform individuals who wish to submit development proposals meeting DAS guidelines that DAS review must be made prior to submission. Local government representatives be present during DAS review for projects in their jurisdictions.

**RECOMMENDATION 2. EACH COUNTY SHOULD DESIGNATE OR EMPLOY A COUNTY ENVIRONMENTAL LAND USE COORDINATOR.**

County planning offices in Delaware consult an advisory committee as part of the application process for site plan and subdivision approval. Comments received from the various agencies represented on the advisory committees include regulatory requirements imposed by each agency as well as suggested changes or additions that some agencies might like to see but cannot legally enforce. Recommended land use decisions by county planning commissions and subsequent final decisions by county councils are heavily influenced by recommendations of the advisory committees.

Advisory committees are in place to inform applicants of policies and procedures to be followed so that a project can be developed in an environmentally sound manner. However, time and other factors often preclude agency representatives, already involved with other responsibilities, to fully review the potential environmental effects of a proposal. To rectify this deficiency, each of the three county governments should designate or employ a county land use coordinator whose job would be to coordinate development plans with state regulatory agencies. The coordinator would be responsible for:

- a. Informing the applicant, the county planning office, county advisory committee and state agencies of all existing regulations affecting the proposed development project.
- b. Identifying means for compliance with regulations that are imposed by each state agency and the county government.
- c. Insuring that written reports are provided to all appropriate parties documenting the manner in which state agency and other comments were considered in the local decision-making process and setting forth the rationale for the decision.

The State should provide financial incentives to each of the county governments to support the work of the coordinator.

RECOMMENDATION 3. THE STATE SHOULD ESTABLISH ONE OR MORE STATE LAND USE COORDINATORS.

The state land use coordinator would work in conjunction with the county land use coordinators and the Development Advisory Service and would be responsible for gathering and reporting state comments on proposed development projects to the county on a timely basis. In instances where there is no state policy or where there are conflicting state policies affecting a particular development project, the state land use coordinator would be responsible for coordinating a single state response and explaining its impact on the proposed development project to appropriate parties.

RECOMMENDATION 4. LEGISLATION SHOULD BE ADOPTED GIVING STATE AGENCIES SUFFICIENT TIME TO DEVELOP RESPONSES TO COUNTY REQUESTS FOR COMMENTS ON PROPOSED DEVELOPMENT PROJECTS.

The time allotted state agencies to analyze development proposals in a thorough manner and submit comments is often insufficient. Approved enabling legislation should be modified to provide sufficient time for state agencies to respond. The amount of time provided in statute should be standard across localities.

RECOMMENDATION 5. PROMOTE COORDINATION OF INFORMATION SYSTEMS.

Computerized data systems will become an increasingly important tool for environmental managers in the future. As these systems develop, land use managers and decision makers will have access to extensive sources of natural resource, cultural, economic and demographic information. Access to such data can lead to improved land use planning and should be encouraged. Coordination of systems will be essential, however, and should be a priority among all users.

### The Need to Implement Growth Management Policies that Enhance Environmental Quality

Governments, households, businesses and land developers all use resources and make investments that continually, but gradually, shape and re-shape the economic structure as well as the natural environment of Delaware. Policies aimed at a healthy, growing economy and a sound environmental legacy rely on signals meant to guide governments, households, businesses and developers in their resource use behaviors. Policy signals, for example, guide how and where solid wastes are disposed of, how water is used in the summer, which land can be used for a shopping center, and how many access points can be cut in a roadway for new businesses. The design of improved environmental management policy signals must take into account the management of growth sufficient to prevent environmental despoliation.

Taxes, particularly the property tax, along with user charges, and fees, are the three different kinds of policy devices that can be used to enhance (or upset) environmental objectives. Public sector taxes, infrastructure prices and fees play a major and continuous role in environmental outcomes. Taxes, user

charges and fee policies must be taken into account when land use-environmental initiatives are made. A primary policy issue for the future is whether infrastructure (roads, sewers) services should be provided in ways that make these services appear to be "free" to users. A related, but somewhat different issue, is whether the capital costs for fixed infrastructure should be funded in ways that mask the true costs of distance.

## **The Need To Focus On Centralized Development**

In 1925 around two thirds of all Delawareans lived inside municipal or town boundaries. Over half of the state's population had their homes or apartments inside the City of Wilmington alone — an area of land that is roughly eleven square miles in size. Access to the countryside for all kinds of non-agricultural uses was thrown open by roads, water systems, cars, trucks, electricity and telephone networks. Public policies provided powerful assistance to decentralization. Low cost access to the land helped create a revolution in extensive land use. Between 1970 and 1980 for example, the highest percentage population growth within New Castle County took place on land south of the Chesapeake and Delaware Canal; while population increase rates were much higher in rural Kent and Sussex Counties than in relatively urbanized New Castle County.

Many noted authors in the field of land use planning and other disciplines have subscribed to the idea that more concentrated and centralized development; as an underlying long-term policy goal, will contribute to a more healthy natural environment. Environmental benefits to be achieved from this approach include reduced encroachment on to natural habitats including open lands, forestlands and marshes. In addition, more compact provision of services and infrastructure by both the private and public utilities would result in substantial benefits to the general public.

### RECOMMENDATIONS

RECOMMENDATION 1. STATE, COUNTY AND MUNICIPAL GOVERNMENTS SHOULD SUPPORT AND ENCOURAGE DEVELOPMENT AND GROWTH INSIDE EXISTING COMMUNITIES AND SHOULD DISCOURAGE INCENTIVES FOR DECENTRALIZATION.

Taxes, charges, and fees, are three different kinds of ways that can be used to help achieve a centralized growth strategy since they affect a variety of private and public decisions which in turn affect the way land will be used.

However, the implications of fees, taxes and certain regulations as they effect environmental quality in the long term must be clearly understood. As a first step, an in-depth analysis of a community of manageable size should be performed to examine how land use decisions have caused changes in a community over a specific period of time. The two-county area of greater Milford is recommended as the study community due to the extensive amount of work recently done by the University of Delaware's College of Urban Affairs and Public Policy and the opportunity to involve several levels of government in the analysis. The analysis will include (a) specific identification of all major public policies that affect land use in the Milford area, (b) appraisals of near and long term policy decisions; and (c)

proposals for realignment and modifications of policies to support centralized land use objectives consistent with a reasonable rate of economic growth for Milford.

**RECOMMENDATION 2. STATE AND LOCAL LAND USE PLANNERS MUST CONSIDER ALL FORMS OF TRANSPORTATION FOR THE MANAGEMENT OF TRAVEL DEMAND.**

Efforts should be made to increase coordination of land development and multi modal transportation interests with a goal of decreasing the burden on existing highway infrastructure, improving the flow of traffic, and aiding in the development of alternative modes of travel. Innovative financing mechanisms which maximize user fees, in conjunction with public and private funding support for both capital and operating costs, should be considered to support these efforts.

**RECOMMENDATION 3. THE STATE SHOULD ENCOURAGE FORMATION OF PUBLIC-PRIVATE ASSOCIATIONS TO DEVELOP ALTERNATIVE METHODS OF TRAVEL THROUGH INCENTIVES AND TECHNICAL ASSISTANCE.**

Such associations should consider all forms of shared ride, public transit promotion, staggered work schedules, off-peak goods movement, telecommuting and other incentives to reduce travel. Additional public transit networks should be considered for growing population centers, i.e., Newark, Dover and the resort area. Where feasible more extensive regional connections with SEPTA to the north, and to New Jersey and points east, should be contemplated.

**RECOMMENDATION 4. INFRASTRUCTURE PRICING SHOULD BE DESIGNED TO SUPPORT LONG-TERM ENVIRONMENTAL PROTECTION AS WELL AS MORE CENTRALIZED LAND USE.**

Impact fees and taxes, which result in a closer correlation of assignment of infrastructure capacity cost with those who create the need for expansion, are in use throughout the country but not in Delaware. Consideration of a highway impact assessment at the state level is strongly encouraged as is utilization of impact fees at the county level. Both the state and the counties could use this financial tool as a basis for directing growth. If a levy were universally applied to development as a tax based upon infrastructure impacts, variations in imposing the tax, such as abatements or credits, could be used as incentives to direct development. This type of growth management approach deserves consideration.

**RECOMMENDATION 5. CREATE INFRASTRUCTURE RESERVE FUNDS.**

Recent trends indicate that federal funding for infrastructure has decreased. Federal funding for wastewater treatment facilities is expected to end in 1990. Federal funding for transportation needs are likely to continue on a declining trend in the years ahead, with the potential for dramatic drops in available funding a serious possibility.

In light of anticipated losses in federal funding for infrastructure, it is recommended that state and local governments develop funding approaches for the creation of infrastructure reserve funds. These should be set up as trust funds dedicated to the replacement of existing infrastructure. Dedicated revenues from user fees or assessments are the first choice for funding.

# TECHNOLOGICAL CAPABILITY

## INTRODUCTION

As illustrated throughout this report, coming to grips with today's environmental issues has been more challenging than dealing with those of the past. Problems which could be seen, smelled or tasted have been exchanged for more subtle, yet highly complex indicators of environmental degradation. In the future the challenge will be even greater. Our ability to accurately predict the effects of man and nature's actions on the environment is very limited and in most situations the scientific and technological means to respond to complex environmental problems is lacking. The cleanup of a toxic waste site is an example where costly research and investigation must take place over protracted periods of time before the risks to public health and the environment can be determined (if they can be determined at all) and remedial actions taken.

As Delaware begins to respond to these increasingly complex environmental problems, it is becoming more and more apparent that the state lacks the technological means to respond to particularly difficult environmental issues. In many instances, problems such as air toxics, ozone, ground water protection, and hazardous waste disposal are not unique to Delaware and have received attention by the federal government. However, despite the considerable resources and expertise at the federal level, progress in resolving these issues has been, at times, agonizingly slow. Like many other states, principally because of resource limitations, Delaware is not likely to be a leader in terms of research, or technological breakthroughs to resolve environmental problems. The state, however, must continue to improve its technological capabilities in order to develop solutions to the state's existing and future environmental problems.

As Delaware's environmental agenda continues to evolve in complexity, it is important that state government be able to tap other segments of the population for technological expertise. While existing citizen advisory bodies are expected to continue serving important future environmental management roles, the need to have access to latest technology and expertise will be particularly important.

In dealing with air quality issues, for example, the report shows a need to bolster the state's air toxic program with scientific/technological skills beyond those that exist in Delaware state government. Similarly, recommendations on waste reduction call for enhanced scientific/technological competency. Equally important will be the technological capability to deal with issues yet uncovered. One particularly pressing need that remains unfulfilled is the capability to effectively assess risk.

## TECHNOLOGY AND RISK ASSESSMENT

Risk assessment is a means to estimate the probability and magnitude of harm from exposure to substances under particular circumstances. Risk assessment is particularly difficult to address since it is virtually impossible to determine the absolute degree of safety from contaminants in the environment.



There are roughly 60,000 commonly used chemicals, and as many as 1,000 new substances introduced yearly. The ability to detect toxic chemical compounds in the environment at low levels is in one sense a blessing while a curse to those who must determine what medical significance "a part per billion of dioxin in a representative dust particle" means to the general public living near a waste incinerator. Our detection technology needs to be linked to a better methodology for determining what health/environmental risks are posed by extremely low levels of toxics.

Because toxic contaminants pervade every environmental media-air, water and land-risk assessment is a necessary component of all aspects of environmental management. But our capability to determine risks and set environmental policy according to "absolutely safe" levels of exposure to contaminants is very limited. The economic costs of attempting to eliminate all risk in society would be staggering and such a goal is practically unreachable. Even limited efforts to reduce such risks will be expensive. Delaware, however, needs to develop and refine its capability to assess risk in order to minimize exposure to toxic materials. To achieve that objective, increased technological capability must be made available to environmental managers.

## RESEARCH - A PREREQUISITE FOR IMPROVED TECHNOLOGICAL CAPABILITY

This report clearly indicates the many questions and challenges to which research has immediate and long-range applications. Informed public decisions, particularly those concerned with environmental health, require information and that information is in large part generated by research. The errors of the past document the requirement that such knowledge be available and utilized. Needed information can only rarely be generated in the event of an emergency; it must anticipate needs. Research directed at environmental issues is data dependent, interdisciplinary, complex, and significant to all members of society. Good public policy and sound regulation are research-dependent, but research and regulations do not mix well because of conflicting demands that distract specialists in both areas.

Developing an improved research capability to deal with a broad range of issues will be essential if Delaware is to resolve complex environmental problems. As indicated, throughout this report, there are a number of environmental issues that will require extensive, long term study before the technological capability will exist to make better informed public policy decisions. Research subjects which will lead to the enhancement of technological capability and which have been recommended in this report include:

- \* Air toxics
- \* Acid rain
- \* Waste reduction
- \* Aquifer recharge
- \* Sea level rise
- \* Ecological processes of the Delaware Estuary
- \* Radon contamination
- \* Biotechnology
- \* Infectious wastes

### RECOMMENDATION

ESTABLISH A TECHNOLOGY ADVISORY COMMITTEE TO ASSIST STATE ENVIRONMENTAL MANAGERS IN DEALING WITH TECHNICALLY COMPLEX ISSUES.

The committee should be established in law and include, but not be limited to, engineers, chemists, geologists, toxicologists, physicians, economists, biologists, agronomists and other scientifically related disciplines. There should be one standing committee, representing a broad spectrum of technological expertise. Where highly specific technical problems present themselves, appropriate specialists would be asked to participate on an ad hoc basis.

The Technology Advisory Committee should be staffed by the Department of Natural Resources and Environmental Control and be in place no later than January 1, 1989.

Major components and responsibilities of the committee should include:

- a. Assist environmental managers in collecting data, setting guidelines and developing regulations.
- b. Design risk assessment methodologies to be used in setting criteria and standards for environmental regulations.
- c. Advise in the development of agency research agendas and research programs to address issues listed throughout this report.

# ENVIRONMENTAL EDUCATION

## INTRODUCTION

A significant, reoccurring theme, echoed by all eight Legacy program committees is the need for widespread environmental education—a better understanding of what makes our environment work and the impacts of man's and nature's actions on that environment. One clearly recognized need is to improve the level of environmental education in our elementary schools. Starting early in the schools will help inculcate an environmental ethic in our youngsters, an ethic that will hopefully remain with them throughout their lives. But that will take time. In the meanwhile, our adult population also needs to be educated.

## ENVIRONMENTAL EDUCATION GOAL

No more significant environmental legacy could be given to following generations than to provide them with a full appreciation of our environment, how it works, and how to protect it. To that end the following goal is proposed.

To Develop a citizenry that is aware of, and concerned about the total environment and its associated problems, and which has the knowledge, attitude, motivations, commitment and skills to work individually and collectively toward solutions of current problems and the prevention of new ones.

The goal captures the concern for improved understanding of our environment shown throughout this report and should serve to guide the direction of the two major environmental education efforts discussed below.

## DEVELOPING AN ENVIRONMENTAL ETHIC IN OUR YOUTH

The main emphasis for kindergarten through 12th grade should be to develop an awareness and attitude toward responsible environmental stewardship. Early exposure to the many relationships, problems and opportunities that characterize our environment will eventually bring about a more intelligent and responsible management of our environment.

## Findings

The current status of environmental education in Delaware public schools can be summarized as follows.

- \* No coordinated, statewide K-12 environmental education program exists nor is there any mandate to develop one. Some individual districts emphasize environmental education while others do not.
- \* There is a statewide Supervisor of Science and Environmental Education in the Department of Public Instruction (DPI). Through this office, inservice programs are made available for interested teachers.

- \* School districts that offer environmental education usually integrate such efforts into the science and social studies courses in the early grades and place it with science at the high school level.
- \* High school students are required to earn 19 credits for graduation. Of these credits, two are required in science - one in biological science and one in physical science. Some school districts require more, e.g., Red Clay Consolidated School District requires 20 credits while the Milford School District requires 21.
- \* Educators generally agree that even when environmental education is required in a district, many teachers are not experienced in teaching it. Inservice programs are the most commonly used method of overcoming this deficiency.
- \* Last year 30 environmental education workshops were conducted by the Department of Public Instruction while others were sponsored by the Delaware Teachers Center.
- \* Project Wild is one of the successful supplementary curricular materials for the classroom. This program, for grades K-12, provides workshops and program materials available to teachers free of charge. The project is sponsored by the Department of Natural Resources and Environmental Control (DNREC) and DPI through a federal grant from the Coastal Management Program.
- \* In addition to DPI there are a number of public and private agencies now involved in environmental education to some degree: DNREC's, Division of Fish and Wildlife in conjunction with the Information and Education Office for Project Wild; The Division of Parks and Recreation in seven state parks through its interpretive program and with its outreach program; the Planning Branch of the Division of Water Resources in conjunction with the Inland Bays Monitoring Committee's education program; the University of Delaware through campus programming, continuing education and its Sea Grant colleges; Delaware State College environmental studies; Delaware Nature Education Society (Ashland and Abbotts Mill Nature Centers) through numerous youth activities and outreach programs such as Stream Watch; the Delaware Audubon Society; Children's Beach House and many more. Each agency does its own programming. There is no statewide coordinated effort. To have a significant impact - to change attitudes and to help form environmental values - a coordinated effort is necessary.
- \* There are between 6,500 and 9,500 children in each public school grade. With these large numbers, a significant input of funds and organizational time is required to institute a comprehensive system of additional youth programs, new requirements, or teacher education.

To help Delaware achieve the environmental education goal the following recommendations are made:

#### RECOMMENDATIONS

RECOMMENDATION 1. ENVIRONMENTAL EDUCATION SHOULD BE TAUGHT IN DELAWARE PUBLIC SCHOOLS, GRADES K-12 WITH THE FOLLOWING PRINCIPLES GUIDING IMPLEMENTATION.

Environmental Education should be integrated into established curriculum and include:

- a. 20 hours of environmental instruction each year for grades K through 3 to include at least ten hours of field instruction each year.
- b. A minimum of 30 hours of environmental education and 16 hours of field instruction each year for grades 4 through 6 with at least one multidisciplinary overnight field experience during one of those four years.
- c. 75 hours of environmental instruction for grades 7 through 9 to include at least six hours of field instruction.
- d. Environmental Education Instruction be given in grades 10-12.

To implement this program, the following additional recommendations are made:

RECOMMENDATION 2. COLLEGE LEVEL ENVIRONMENTAL EDUCATION COURSES SHOULD BE REQUIRED FOR CERTIFICATION OF APPROPRIATE TEACHERS AS FOLLOWS:

- a. A three credit college level environmental education course be required for certification for all elementary teachers and all secondary science teachers.
- b. Delaware State College and the University of Delaware be informed of this environmental education requirement for certification.
- c. At least one credit of environmental education (inservice or college) be required each 5 years for recertification for all elementary teachers and all secondary science teachers.

RECOMMENDATION 3. THE FOLLOWING SUPERVISORY AND INSTRUCTIONAL SUPPORT SHOULD BE EMPLOYED:

- a. To coordinate the statewide program in the school districts, supervise field agents and other functions, the current Supervisor of Science and Environmental Education position needs to be divided. The new position would be that of an Environmental Education Supervisor.
- b. To help provide for teacher inservice in environmental education, to assist with field experiences, to be a resource for classroom assistance and to help monitor implementation of the environmental education program, field agents and support staff need to be employed.

RECOMMENDATION 4. DELAWARE'S MAJOR PUBLIC AND NONPUBLIC ENVIRONMENTAL EDUCATION AGENCIES SHOULD FORM A FORMAL NETWORK TO MONITOR THE IMPLEMENTATION OF THE K-12 ENVIRONMENTAL EDUCATION PROGRAM; TO ADVISE ON ENVIRONMENTAL EDUCATION ISSUES; AND TO ASSURE ADEQUATE COORDINATION OF PROGRAMS.

It is suggested that the agencies represented in the environmental education network include: Department of Public Instruction, Department of Natural Resources and Environmental Control, Department of Agriculture, Delaware State College, University of Delaware, Delaware Nature Education Society, Delaware Audubon Society, Delaware Wildlife Federation, Delaware State Education Association, and the Education Committees of the Delaware Legislature.

RECOMMENDATION 5. IMPLEMENTATION OF THE K-12 ENVIRONMENTAL EDUCATION PROGRAM, SHOULD BE PHASED IN AS FOLLOWS:

- FY 89 - Establish the Environmental Education implementation monitoring process.
- FY 90 - Implement a Public Relations program, and develop a constituency to support program.
- FY 91 - Implement instruction and certification of teachers.
- FY 92 - Implement - the field agent system (three agents to collect materials, develop curricula, and begin training for grades K-3).
  - Implement K-3 program.
- FY 93 - Increase the number of field agents (add three agents and begin training for grades 4-6).
  - Implement grades 4-6 program.
- FY 95 - Implement grades 7-9 program.
- FY 97/98/99 - Implement grades 10-12 program.

## ADULT ENVIRONMENTAL EDUCATION

### Introduction

Environmental education is a continuing process that should not be restricted to young people alone. Methods of maintaining a healthy environment are changing rapidly with new technology, and basic concepts must be retaught to each generation.

In the past, environmental education for adults has largely been a function of nongovernmental organizations. State environmental agencies traditionally spend very little educating the public -- the same public who is asked to pay the taxes and obey the regulations necessary for a healthy environment. There is a growing realism that to achieve real success the governmental role in

environmental education must be increased. Highly complex environmental issues are many times beyond the capability of private environmental education groups to clearly articulate to other citizens.

## Methods to Educate the Public

### Publications

#### The Delaware Conservationist (Periodical)

The principal means by which environmental education has been disseminated in Delaware has been through the Department of Natural Resources and Environmental Control's quarterly Delaware Conservationist. The conservationist contains informative articles, mostly authored by local experts both in and outside of government on all phases of the environment. The conservationist is currently being distributed to about 17,000 subscribers without charge. The Conservationist is attractive and well edited but its readership is limited. Occasionally, articles are written with a single viewpoint, particularly on controversial environmental issues.

#### Newsletters

Newsletters, containing basic environmental information are mostly a product of private environmental groups. Those issued by Delaware Audubon Society, Delaware Museum of Natural History, Delaware Nature Education Society, Ducks Unlimited, Delaware Wild Lands, Inc. and the Water Resource Center of the University of Delaware are of top quality. Recently, consideration has been given to the publication of newsletters by various divisions within DNREC to supplement articles published in The Delaware Conservationist or to deal with specialized subjects not of general interest.

#### RECOMMENDATIONS

- RECOMMENDATION 1. THE CIRCULATION OF THE DELAWARE CONSERVATIONIST SHOULD BE GRADUALLY RAISED TO 50,000.
- RECOMMENDATION 2. AN EDITORIAL ADVISORY BOARD BE FORMED REPRESENTING A VARIETY OF GOVERNMENTAL AND PRIVATE INTERESTS TO ADVISE ON POLICY PERTAINING TO CONTENTS OF THE DELAWARE CONSERVATIONIST.
- RECOMMENDATION 3. THE INFORMATION AND EDUCATION OFFICE OF DNREC PUBLISH A CALENDAR OF ALL ENVIRONMENTAL EDUCATIONAL EVENTS THROUGHOUT THE STATE ON A REGULAR BASIS BY MEANS OF A NEWSLETTER WITH A DISTRIBUTION OF 50,000.
- RECOMMENDATION 4. THE INFORMATION AND EDUCATION OFFICE OF DNREC PUBLISH AND DISTRIBUTE ALL DEPARTMENTAL NEWSLETTERS WITH TECHNICAL ASSISTANCE FURNISHED BY THE RESPECTIVE DIVISIONS. THIS WILL HELP TO ASSURE HIGH STANDARDS AND WILL BE MORE ECONOMICAL.
- RECOMMENDATION 5. PRIVATE ORGANIZATIONS SEEK PROFESSIONAL GUIDANCE IN METHODS OF PROMOTING, DESIGNING, WRITING AND DISTRIBUTING NEWSLETTERS.

### Newspapers, Magazines and Information Sheets

Newspapers published throughout the state give much coverage to environmental matters. The quality of reporting varies greatly, in part because of the turnover of staff in some weekly papers.

Other publications such as "Delaware Today" and "Delaware Lawyer" occasionally carry an environmental message. Their audiences are small but include people of both affluence and influence.

Information sheets answering common environmental questions are used effectively by the University of Delaware's Agricultural Extension Service and the U.S. Department of Agriculture's Soil Conservation Service. These are mailed in reply to telephone inquiries or distributed at field demonstrations and other meetings.

### RECOMMENDATIONS:

- RECOMMENDATION 1. DNREC IN COOPERATION WITH PRIVATE ENVIRONMENTAL GROUPS CONDUCT SEMINARS TO ACQUAINT REPORTERS AND EDITORS WITH ENVIRONMENTAL ISSUES AND THE AGENCIES AND ORGANIZATIONS CONCERNED WITH ENVIRONMENTAL MANAGEMENT, AND TO ACQUAINT WRITERS WITH EACH OTHER AND WITH PERSONS WORKING IN THE ENVIRONMENTAL FIELD.
- RECOMMENDATION 2. STATE AND PRIVATE ENVIRONMENTAL ORGANIZATIONS EXPAND THE PRODUCTION AND DISTRIBUTION OF INFORMATION SHEETS TO FURNISH THE INQUIRING PUBLIC WITH ANSWERS TO THEIR ENVIRONMENTAL CONCERNS.
- RECOMMENDATION 3. DNREC'S INFORMATION AND EDUCATION OFFICE SHOULD PREPARE A DIRECTORY OF ENVIRONMENTAL RESOURCES WHICH WOULD INCLUDE THE NAMES, LOCATIONS, PURPOSES AND CURRENT ACTIVITIES OF ALL ENVIRONMENTALLY RELATED PUBLIC AND PRIVATE ORGANIZATIONS IN THE STATE.

### **Television and Radio**

Television is the dominant media in the home. Although Delaware does not have a major commercial outlet, the area is served from Philadelphia, Salisbury, Baltimore and by Public Broadcasting and cable from Wilmington. Adult environmental education programming as opposed to current news is shown principally by channel 12 with emphasis on such series as Nature, Nova, Odyssey and a variety of films featuring wild plants and animals not found in Delaware.

DNREC and other state environmental agencies are currently experimenting with video tapes for use on public TV. Private environmental organizations, with some state assistance, are creating educational short "fillers" which are shown principally on channel 12.

Radio stations are usually readily available for environmental education. The agricultural interests make heavy use of radio to reach audiences with pertinent information and education. Other environmental agencies do not make comparable use of this medium. Some private environmental educational organizations furnish statewide public service programming on a regular basis.



## RECOMMENDATIONS

- RECOMMENDATION 1. DNREC AND OTHER APPROPRIATE STATE AGENCIES COOPERATE TO PRODUCE HIGH QUALITY EDUCATIONAL PROGRAMMING FOR ADULT TV VIEWERS ON A FREQUENT AND SUSTAINED BASIS. PROFESSIONAL VIDEO TAPE PRODUCERS SHOULD BE ENGAGED TO PERFORM THIS SERVICE. STATE ENVIRONMENTAL AGENCIES MAINTAIN A TRAINED STAFF TO IDENTIFY EVENTS SUITABLE FOR TV AND TO FOLLOW THROUGH ON THEIR PRODUCTION.
- RECOMMENDATION 2. PRIVATE ENVIRONMENTAL EDUCATION ORGANIZATIONS EXPAND THEIR PRODUCTION OF VIDEO TAPES WITH FINANCIAL ASSISTANCE FROM STATE AGENCIES E.G., DNREC, DELAWARE DEPARTMENT OF AGRICULTURE, DEPARTMENT OF PUBLIC INSTRUCTION, DELAWARE DEVELOPMENT OFFICE, ETC.
- RECOMMENDATION 3. DNREC USE PUBLIC SERVICE RADIO SPOTS FOR HIGH QUALITY ENVIRONMENTAL EDUCATION ON A FREQUENT AND SUSTAINED BASIS.
- RECOMMENDATION 4. PRIVATE ENVIRONMENTAL EDUCATION ORGANIZATIONS STEP UP THEIR USE OF PUBLIC SERVICE RADIO ANNOUNCEMENTS (PSA) FOR HIGH QUALITY ENVIRONMENTAL EDUCATION.
- RECOMMENDATION 5. OTHER CREATIVE RADIO PROGRAMS, OTHER THAN PSA, SUCH AS STORY TELLING, QUESTION AND ANSWER SHOWS AND QUIZ BOWLS, BE DEVELOPED BY BOTH PUBLIC AND PRIVATE ENVIRONMENTAL ORGANIZATIONS.

### **Continuing Education for Advisory Board Members and Agency Staff**

Members of advisory boards to the state's environmental agencies are not required or encouraged to take any structured training in the fields from which they are asked advice or for which they provide leadership. Similarly, staff members in state agencies are not required to advance their knowledge of environmental sciences. Only enforcement personnel within DNREC are required to receive training outside their organization. However, various staff members in other areas have taken the initiative and are permitted to take courses at the University of Delaware, Delaware State College, Wesley College and other institutions that lead to degrees in environmental sciences. There is no known policy that encourages this initiative.

In order to improve environmental awareness among agency staff members and advisors, continuing in-house and/or academic training is essential. A program of continuing education provides both staff and advisors with new knowledge in scientific fields that are constantly expanding. Continuing education also provides an opportunity for employees who wish to advance professionally. Continuing education can also be a source of technical information and education for those who are appointed to the various advisory boards. At the present time, the state policies and programs for such training and educational opportunities are fragmented and incomplete.

## RECOMMENDATIONS

- RECOMMENDATION 1. STATE ENVIRONMENTAL AGENCIES ESTABLISH PROGRAMS TO PROVIDE AND ENCOURAGE IN-HOUSE TRAINING FOR STATE EMPLOYEES AND MEMBERS OF ADVISORY BOARDS AND FOR LOCAL GOVERNMENTAL OFFICIALS.
- RECOMMENDATION 2. APPOINTEES TO ADVISORY BOARDS BE GIVEN AN ANNUAL, GENERAL ORIENTATION SESSION CONCERNING CURRENT ENVIRONMENTAL ISSUES AND RESPONSIBILITIES OF THEIR ASSIGNED AGENCY. THE BOARD MEMBERS SHOULD ALSO BE ENCOURAGED TO PARTICIPATE IN OTHER TRAINING SESSIONS AND ACADEMIC PROGRAMS RELATING TO THEIR AREAS OF RESPONSIBILITY.
- RECOMMENDATION 3. INSTITUTIONS OF HIGHER LEARNING IN DELAWARE THAT OFFER COURSES IN ENVIRONMENTAL SCIENCES BE REQUESTED TO DEVELOP COURSES AND SCHEDULES TO MEET THE NEEDS OF STATE EMPLOYEES, THEIR ADVISORY BODIES AND LOCAL GOVERNMENTAL OFFICIALS.

## Lectures, Field Trips, Exhibits, Etc.

Lectures, field trips, exhibits, symposia, workshops, movies, special events and seminars which are designed to attract and educate the adult public are given by a host of organizations, agencies and institutions serving the Delaware area. They include the American Association of University Women, Boy Scouts of America, Brandywine Valley Association, Brandywine Conservancy, Citizens for Clean Air, Coalition for Natural Stream Valleys, County Conservation Districts, Delaware Academy of Science, Delaware Audubon Society, Delaware State College, Delaware Department of Agriculture, Delaware Department of Natural Resources and Environmental Control, Delaware Geologic Survey, Delaware Solid Waste Authority, Delaware Lung Association, Delaware Museum of Natural History, Delaware Nature Education Society, Delaware Wild Lands, Inc., Delaware Wildlife Federation, Delmarva Ornithological Society, Ducks Unlimited, Forward Lands, Inc., Garden Clubs, Girl Scouts of America, League of Women Voters, Longwood Gardens, Natural History Society of Delaware, Port Penn Historical Society, Red Clay Creek Valley Association, Sierra Club, Soil and Water Conservation Society, St. Jones Watershed Association, Tri-state Bird Rescue and Research, Trout Unlimited, University of Delaware, U.S. Fish and Wildlife Service, U.S. Soil Conservation Service, Wesley College, Winterthur, Womens' Clubs, and others. It is estimated that more than 300 of these events occur each year, not counting the interpretive programs at parks, museums and environmental centers throughout the state. Collectively, they are attended by hundreds of thousands of persons. Authorities from all environmental fields participate in these events, some traveling to Delaware from other state and countries. Some events, such as Coast Day, sponsored by the College of Marine Studies, draw huge throngs. At the other extreme, smaller events draw a handful of the faithful who are committed to high environmental standards.

## RECOMMENDATIONS

- RECOMMENDATION 1. ALL MAJOR STATE PARKS, FORESTS AND WILDLIFE AREAS PROVIDE HIGH QUALITY EDUCATIONAL EXHIBITS AND PROGRAMS DURING PERIODS OF PEAK USE. This can be done in cooperation with private environmental organizations which could adopt areas and raise some of the necessary funding from a variety of sources including corporate grants.

- RECOMMENDATION 2. THE DNREC WITH ASSISTANCE FROM OTHER ORGANIZATIONS ORGANIZE AND GROUP A NUMBER OF ENVIRONMENTAL COURSES AND EDUCATIONAL EVENTS INTO IDENTIFIABLE SERIES FOR THOSE WHO WOULD LIKE TO COMPLETE ALL OF A SERIES AND RECEIVE CERTIFICATION AND PUBLIC RECOGNITION FOR IT.
- RECOMMENDATION 3. EXHIBITIONS AT MUSEUMS AND ENVIRONMENTAL CENTERS BE UPGRADED WHERE NECESSARY TO TAKE ADVANTAGE OF NEW AND PROVEN TECHNIQUES WHICH ATTRACT AND EDUCATE. TO HELP ACCOMPLISH THIS, IT IS RECOMMENDED THAT THE DELAWARE MUSEUM OF NATURAL HISTORY CONDUCT AN INDOCTRINATION SEMINAR ON THIS SUBJECT FOR PRIVATE AND PUBLIC ORGANIZATIONS.

### **Institutions of Higher Learning**

The University of Delaware, Delaware State College, Wesley College, and Delaware Technical and Community College as a group, offer more than fifty courses in the environmental sciences. Undergraduate degrees relating to environmental studies are given at the University of Delaware in the colleges of Agricultural Sciences, Education, Physical Education, Athletics and Recreation and Arts and Science; at Delaware State College in the Department of Agriculture and Natural Resources; at Wesley College in the Department of Biology. Graduate degrees are given at the University of Delaware in the Colleges of Marine Studies, Urban Affairs and Public Policy and Engineering as well as in some of the undergraduate fields mentioned above.

Several professional societies undertake to accredit universities and colleges. Of particular concern is that no Delaware institution is accredited to offer degrees in parks and recreation and in wildlife management. This is likely to be the result of inadequate facilities, staffing and curriculum.

Although courses in art appreciation are given for nonartists and music appreciation for those who do not play instruments, few courses in environmental science appreciation are offered to the large majority of college students who will not become scientists, but will live in a world environment greatly influenced by scientific thought and actions.

For retirees and postgraduates, the university's Academy of Lifelong Learning offers a variety of opportunities for further education. To date, little emphasis has been placed on environmental studies.

- RECOMMENDATION ESTABLISH A DELAWARE ENVIRONMENTAL INSTITUTE, CONSISTING OF A COALITION OF DELAWARE COLLEGES AND UNIVERSITIES TO PROVIDE A BROAD SPECTRUM OF PROFESSIONAL ENVIRONMENTAL EDUCATION. Such an institution would:
- a. Establish inter-institutional arrangements for the training of students in the environmental sciences.
  - b. Consolidate and modify courses now offered into programs with adequate strength, breadth and support to warrant accreditation in the fields where they are lacking.

- c. Establish environmental science appreciation courses for nonscientists at the undergraduate college level and to postgraduates at the Academy of Lifelong Learning.
- d. Establish and provide programs for in-house training of state employees and members of advisory boards and local governmental officials. (See Recommendation 3 on page 155).

FINAL RECOMMENDATION

CREATE A COUNCIL OF ADVISORS TO HELP IMPLEMENT THE ADULT ENVIRONMENTAL EDUCATION PROGRAM.

# A CALL FOR HOLISTIC ENVIRONMENTAL MANAGEMENT

## INTRODUCTION

We cannot manage our environmental resources tomorrow as we have done in the past. The most serious environmental challenges facing us have cumulative impacts which affect all elements of nature. Up to now we have pretty much responded only after a problem was noticed and often in a piecemeal fashion. Tomorrow, we must do our best to anticipate problems before they occur and develop the means to resolve them in a multidisciplinary, integrated fashion.

Holistic environmental management recognizes the environment as an ecosystem where each element of nature affects the whole. The solutions which come from such a management approach incorporate multidisciplinary strategies that consider long-term consequences and provide the public with the opportunity to become a part of the solution.

Man has only recently begun to appreciate the cumulative, long-term effects of his actions on the environment. For example, consider these global problems:

- \* Deforestation in the Amazon River Basin was ostensibly justified to create jobs and boost the region's economy. Today, thousands of square miles of habitat have been destroyed. Continued, unrestricted deforestation may even eventually threaten the world's supply of oxygen.
- \* The commercial application of chlorofluorocarbons was hailed as a miracle in climate-control technology. Today we recognize not only the cancer risks associated with handling those products, but that the chemical's buildup in the atmosphere has created a huge hole in the earth's ozone layer over Antarctica that threatens man with dangerous levels of ultraviolet rays from the sun.
- \* The vast oceans have been used for years by man to dispose of wastes and as an alternative to land disposal. Today, these wastes make beach-going dangerous along many shores and threaten thousands of marine animals and plant life.

Each of these environmental issues is the result of shortsighted actions which failed to consider the cumulative effects. The way we currently manage our environmental resources contributes to the problem. We appropriate funds, develop policy and organize staff along traditional functional lines, (such as air, water, waste) and fail to recognize the relationships among environmental problems. Political boundaries create artificial geographic barriers to regional environmental solutions. The public rightfully demands prompt action, yet this pressure creates the political atmosphere for quick fix, rather than long-term solutions. Further, the complexity and scope of today's environmental issues cause many to become so bewildered that they disassociate themselves from the problems, thus removing the private sector and general public from becoming a part of the solution.

## PRINCIPLES OF HOLISTIC ENVIRONMENTAL MANAGEMENT

The principles of holistic environmental management can be described as follows:

- . Environmental issues are addressed in a multidisciplinary fashion to identify all aspects of the issue.
- . Projections are made to help gauge the long-term consequences of the issue on the environment, economy and population.
- . Cost-benefit and risk analysis is conducted to identify tradeoffs and inform the public of choices to be made.
- . The public fully participates in issue identification, risk analysis and strategic planning and development.

Overall, the aim of a holistic environmental management approach should be to bring environmental considerations into play with other factors early in the planning and decision-making process. When considered in such an integrated fashion at this stage, a more thorough review and informed decision can be made on the impacts and cost-benefits of any action.

## FOUR CHALLENGES TO DELAWARE REQUIRING A HOLISTIC APPROACH

Delaware's wetlands and surface water resources are one aspect of our natural environment that has had a holistic environmental management approach proposed. (See Part III). However, there are a number of other strategic issues that must be managed in a similar fashion to properly safeguard our environment in the future. The following are among those issues having potentially, significant cumulative, long-term environmental impacts that speak to the need for a holistic management approach.

1. Urbanization of New Castle County. The impact of economic development is no more clearly seen than in New Castle County. Open space is vanishing, traffic congestion is at an all time high and the water and waste infrastructures are becoming overburdened. The county is becoming an example of urban sprawl. Coordination appears lacking, decision-making occurs incrementally and development planning has not kept pace with development pressures.
2. Utilization of the Delaware Bay. There is evidence that the environmental quality of the Delaware Bay is improving. Yet as improvements occur, pressures for recreational space will increase bringing man into greater potential conflict with many fragile ecological areas along the coast. Further, development pressures are likely to continue as available port space is limited in the region and the bay's natural conditions and location make it an ideal site for economic interests.
3. Construction of the East-West Highway in Sussex County. While traffic problems demand serious consideration of the highway, we are not in a position to identify the cumulative impacts of this proposal. What effect will it have on housing and recreational demands on the beaches and Inland Bays? Will it open up Sussex County for additional unplanned development? What will be the effect on agricultural lands, freshwater wetlands and other open space areas?

4. Impact of Route 13 Relief Route. Nearly every citizen in Delaware recognizes the need to relieve traffic along our only major north-south arterial highway. It is difficult to not support the relief route given current development projections. But have we adequately considered what impact the highway will have by opening up lower Delaware to development? Can we properly manage growth alongside the highway to protect sensitive adjacent natural areas?

The Route 13 Relief Route is also an example of the shortcomings of our current environmental management system. Extensive engineering, traffic and environmental studies were completed for this project. They are generally considered the most comprehensive in the state's history and have been recognized through international awards. Yet the planning process largely focused on impacts caused only by the direct path of the highway and the planning assumptions were a defacto admission that development pressures will continue to increase unabated in all three counties. The Department of Transportation cannot be faulted. Rather the process raises questions about our current ability to address such issues in a comprehensive fashion when so many questions remain unanswered.

#### RECOMMENDATIONS

- RECOMMENDATION 1. THE STATE SHOULD DEVELOP A THREE-YEAR STRATEGIC PLAN TO GUIDE STATE ENVIRONMENTAL POLICY AND PROGRAM DEVELOPMENT.

The plan should focus on key strategic issues and objectives, include procedures that reflect holistic management principles and serve as a framework for budget priorities. The plan should reflect goals, objectives and recommendations contained in the Delaware Environmental Legacy report.

- RECOMMENDATION 2. STATE AGENCIES CHARGED WITH ENVIRONMENTAL MANAGEMENT RESPONSIBILITIES SHOULD BE REPRESENTED ON ALL APPROPRIATE ENVIRONMENTAL, ECONOMIC DEVELOPMENT, TRANSPORTATION, COMMUNITY DEVELOPMENT, HOUSING AND INFRASTRUCTURE-RELATED BODIES/PROJECTS TO ASSURE ENVIRONMENTAL INPUT.

- RECOMMENDATION 3. SPECIFIC INDIVIDUALS AT THE DEPARTMENT, DIVISION AND PROGRAM LEVELS IN STATE GOVERNMENT SHOULD BE CHARGED WITH THE PLANNING AND COORDINATION RESPONSIBILITIES OF HOLISTIC ENVIRONMENTAL MANAGEMENT.

Within Departments and divisions, formal networks or communication methods should be established to facilitate timely issue identification and resolution. Exact staffing levels and resource requirements will vary. In some cases existing staff may be designated, in others new staff may be required. However, in all cases, each environmental issue should be initially reviewed by a multidisciplinary team and an appropriate project manager assigned to assure coordination with other appropriate functions/disciplines.

RECOMMENDATION 4. THE GOVERNOR SHOULD ESTABLISH THE OFFICE OF STATE PLANNING AND COORDINATION IN STATUTE AND PROVIDE IT WITH THE NECESSARY AUTHORITY TO ASSURE POLICY-LEVEL COORDINATION ACROSS DEPARTMENTAL LINES.

The office should focus on identifying strategic issues which may impact the environment and take steps to assure that the appropriate departments are working on solutions. Further, the office should assure proper coordination with regional, local and other non-state government or private agencies. The role of the office should not be to directly manage programs, but rather to serve as a planning and coordinating function.



## **PART V**

# **IMPLEMENTATION PROCESS**

## PART V

### IMPLEMENTATION PROCESS

An organized effort is needed to guide the implementation of proposed policies, programs and other recommendations contained in this report and to continue the broad public participation begun during the legacy program.

The following steps are recommended to provide the citizen participation, accountability and public awareness needed to ensure the legacy report becomes a dynamic, living document.

#### RECOMMENDATIONS:

RECOMMENDATION 1. THE GOVERNOR SHOULD APPOINT AN ENVIRONMENTAL LEGACY IMPLEMENTATION TEAM WHICH WILL BE RESPONSIBLE FOR THE OVERSIGHT OF PROGRAM IMPLEMENTATION.

This Team should be composed of several community members who served on the steering committee and several key state and local governmental officials or other individuals. Responsibilities of the team would include the following:

Sponsor a series of implementation workshops to: a) identify parties responsible for carrying out recommendations; b) establish implementation schedules; c) prepare fiscal statements for carrying out each legacy program recommendation; and d) conduct any other actions needed to implement recommendations. This work should be compiled into an implementation report by October 1, 1988 and sent to the Governor and all those responsible for implementation actions.

Serve as an advocate for the implementation of needed legislation, budgets, programs, regulations, policies, studies and future research, and lobby for such at the state, local, regional and national levels.

Take lead responsibility for implementing legacy report recommendations dealing with adult environmental education. Specific objectives should be developed to improve the public's willingness to accept greater stewardship for natural resources.

Submit an annual progress report (beginning on January 1, 1989) to the governor, general assembly and all responsible implementation parties. This report should be designed to generate considerable public attention and include key indicators the public may use in evaluating progress made towards environmental improvements.

## APPENDIX

## DELAWARE ENVIRONMENTAL LEGACY

### TELEPHONE SURVEY

As part of an "information base" developed for the first symposium of the Delaware Environmental Legacy Program, a survey was undertaken to gauge the general public's concerns on the most pressing environmental issues the State must address. The survey, conducted by the University of Delaware's College of Urban Affairs and Public Policy, was administered during a two week period in August of this year. Questions asked in the survey touched on such issues as who should be responsible for protecting the environment, what is the quality of our State's environment, how well is the State carrying out its environmental management responsibilities, and what are the most important environmental problems in Delaware. Information was solicited over the telephone from 300 residents across Delaware.

Respondents to the survey strongly agreed with the statement that every person is responsible for protecting and improving the quality of the natural environment. In addition, 65% of respondents would support more taxes or higher prices, if necessary, to achieve this goal for future generations.

A majority of respondents rated the quality of Delaware's air, water, coastal areas and natural areas and parks good to outstanding. A high percentage of respondents (75%) rated the State's efforts to protect the environment adequate to good.

On a statewide basis, air pollution was identified as the most important environmental problem facing Delaware. When examined on a county level, however, air pollution was identified as the top problem in New Castle, industrial pollution was the top concern in Kent, and water pollution was the top concern in Sussex.

Perhaps the most surprising result of the survey was the response to the question on whether hazardous waste disposal site would be acceptable within 10 miles of home if the facility met all federal and state regulations. The results indicated that 52% of respondents would not accept such a site while 41% would find such a site acceptable.

The results of all questions are noted in the following pages as well as significant differences in answers by county, age and sex.

- #1 Do you strongly agree, agree, disagree, or strongly disagree with the following statement?

"Every person is responsible for protecting the quality of the natural environment and improving it, if possible, for future generations."

Strongly agree	53.7%
Agree	36.3%
Disagree	1.3%
Strongly Disagree	8.7%

- #2 Would you be willing to take any of the following actions to help assure a clean and healthful environment for the future?

- a. Use fewer hazardous products in your home by finding substitutes for them or by reducing quantities used, even if it was less convenient.

Yes	95%
No	2.3%
Did not know	2.7%

- b. Participate in household hazardous waste collection programs by depositing your hazardous wastes in collection centers.

Yes	89.3%
No	7.3%
Did not know	3.3%

- c. Become more informed on environmental issues.

Yes	93%
No	4.7%
Did not know	2.3%

- d. Join with other people to become citizen guardians of our air and water quality and critical natural areas.

Yes	75%
No	17%
Did not know	8%

Responses to question 2d varied significantly when analyzed by county. Yes responses to this question, by county, are noted below:

New Castle	70%
Kent	78%
Sussex	92%

- #3 Who should be most responsible for protecting the quality of our air, water and landscape?

Government	41.3%
Individual persons	30%
Private industry	25.7%
Did not know	3%

While government was the top choice from New Castle County respondents (46%), Kent and Sussex County respondents felt individual persons should be most responsible for protecting the quality of our air, water and landscape (Kent 40%, Sussex 44%)

- #4 Do you strongly disagree, disagree, agree, or strongly agree with the following statement?

"You cannot have an environment without some degree of environmental pollution and health hazard. The public must accept some degree of risk if they choose to have the conveniences and pleasures of modern technology?"

Results - Strongly agree	13%
Agree	65%
Disagree	12.7%
Strongly Disagree	7.7%

- #5 How would you rate Delaware state government's efforts to protect our natural environment.

Results - Good	35%
Adequate	40.3%
Poor	15.3%
Did not know	9.3%

From a county perspective, Kent County respondents were more likely to give state government a good rather than adequate rating (52% good vs 44% adequate). The reverse was true in New Castle County (31% good vs 39% adequate) and Sussex County (34% good vs 42% adequate)

- #6 Please tell us if you think the following are very important, somewhat important, or not important reasons that Delaware's state government is not doing its best to protect the environment.

a. Political pressure room business interests.

Very important	41%
Somewhat important	35%
Not important	9%
Did not know	15%

- b. Poorly written, unnecessarily complex, confusing laws and regulations.

Very important	44%
Somewhat important	27.3%
Not important	12%
Did not know	16.7%

- c. Technology hasn't been adequately developed.

Very important	28.3%
Somewhat important	33.7%
Not important	22.3%
Did not know	15.7%

- d. Insufficient budget.

Very important	35.7%
Somewhat important	30.3%
Not important	19.3%
Did not know	14.7%

- e. Staff deficiencies in numbers and/or qualifications.

Very important	37.7%
Somewhat important	27.7%
Not important	11.7%
Did not know	23%

- f. Lack of opportunities for the public to be aware of, and to participate in, environmental protection decisions.

Very important	47.7%
Somewhat important	26.3%
Not important	12.3%
Did not know	13.7%

Further analysis of this question indicated that 50% of those who felt that the lack of public participation and awareness was a very important reason why the State government was not doing its best to protect the environment answered yes to the question on whether they would be willing to become more informed on environmental issues (#2c)

- #7 If circumstances dictated that Delaware needed its own hazardous waste disposal site, would you accept such a site within 10 miles of your home, if it met all federal and state regulations?

No	52.3%
Yes	41.0%
Did not know	6.7%

When analyzed by age it was found that a larger percentage of respondents under 54 years of age would not accept a hazardous waste disposal site while a greater number of respondents 55 years of age or older would accept a hazardous waste disposal site.

7a. If you answered no or don't know to Question #7, what should be done to protect our environment from hazardous waste?

Take them to an area of the state farther from my home for disposal.

Yes	16.8%
No	83.2%

Take them to another state for disposal.

Yes	12.7%
No	87.3%

Incinerate them at an ocean site.

Yes	16.5%
No	83.5%

Reduce the quantity by recycling products (such as waste motor oil) or by finding harmless substitute products.

Yes	91.9%
No	8.1%

#8. Using the following scale -- outstanding, good, fair, poor -- please rate the quality of Delaware's:

a. Air

Outstanding	6%
Good	50.3%
Fair	32%
Poor	9%
Did not know	2.7%

A county breakdown of those answering this question yielded the following:

	<u>Outstanding</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>
New Castle	2.5%	45%	38%	11.5%
Kent	16%	62%	20%	2%
Sussex	10%	60%	20%	6%



b. Water

Outstanding	5.7%
Good	49.3%
Fair	29.7%
Poor	14.0%
Did not know	1.3%

c. Wetlands

Outstanding	4.7%
Good	30.3%
Fair	23.0%
Poor	10.7%
Did not know	31.3%

d. Coastal areas

Outstanding	9.0%
Good	46.3%
Fair	23.3%
Poor	8.3%
Did not know	13.0%

The results of the county breakdown of those answering this question are noted below:

	<u>Outstanding</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>
New Castle	7.5%	41.5%	22%	10.5%
Kent	18%	58%	20%	4%
Sussex	6%	54%	32%	4%

e. Natural areas and parks

Outstanding	14.0%
Good	63.3%
Fair	14.7%
Poor	3.0%
Did not know	5.0%

#9 Would you support more taxes and/or higher prices, if that is necessary, to protect and improve environmental quality?

Yes	65.3%
No	29.3%
Did not know	5.3%

a. If you said yes to question 9, what type of revenue source should support these actions?

Personal income tax revenue	16%
Corporate income tax revenue	60%
Business license revenue	5.3%
Real property transfer tax revenue	3.3%
Voluntary private donations	15.3%

#10 What are the three most important environmental problems in Delaware?

Air Pollution	14%
Water Pollution	12.3%
Industrial Pollution	10%
Coastal Areas	5.3%
Highway Trash Litter	4.7%
Chemicals/toxic wastes	4.3%
Waste Disposal and landfills	4.0%
Traffic	2.7%
Delaware River	1.3%
Nuclear Plants and wastes	1.3%

Other responses receiving 1% or less were: wetlands, overpopulation, farmland, drinking water supply, noise at Dover Air Force Base, oil spills, insecticide, sewage, insects, inadequate recycling, forest fires, wildlife, ozone levels, and industrial plants in Delaware City.

The top three issues, by county, are noted below:

	New Castle	Kent	Sussex
#1	Air Pollution (19.5%)	Industrial Pollution (32%)	Water Pollution (16%)
#2	Water Pollution (13%)	Highway overcrowding (16%) and trash	Coastal Areas (14%)
#3	Chemical and (6%) toxic wastes	Coastal Areas (6%) Water Pollution (6%)	Highway Trash (6%)

A breakdown of those that responded "did not know" to this question, by county, was as follows:

New Castle	25%
Kent	24%
Sussex	32%

**STATE OF DELAWARE**



**EXECUTIVE DEPARTMENT  
DOVER**

**EXECUTIVE ORDER  
NUMBER 34**

**TO: HEADS OF ALL STATE DEPARTMENTS AND AGENCIES**

**RE: DELAWARE ENVIRONMENTAL LEGACY PROGRAM**

WHEREAS, the uniqueness and diversity of Delaware's natural resources are a major determinant of the State's quality of life; and

WHEREAS, the quality of life for future generations will be affected by present and future decisions regarding the management and preservation of these resources; and

WHEREAS, such decisions should be formulated through a process that gives maximum consideration to the collective concerns and desires of the citizens of Delaware.

NOW, THEREFORE, I, MICHAEL N. CASTLE, by virtue of the authority vested in me as Governor of the State of Delaware, do hereby declare and order that:

1. The Delaware Environmental Legacy Program is hereby created.

2. Said Program shall be developed by a broadly inclusive group representative of the environmental community, business community, industrial community, agricultural community, academic community, and state and local government.
3. The Program's mission shall be to identify the emerging critical issues and problems the State will face concerning protection of the environment. The perspective and needs of various segments of Delaware's community should be considered in formulating a long-range strategy to preserve the quality of the environment for future generations.
4. Objectives of the Program are to:
  - a) Gather and evaluate the general public's opinion as to Delaware's emerging long-term environmental issues.
  - b) Create broad State and local understanding of the the interrelationships between quality of life, economic development and the management and protection of natural resources.
  - c) Develop an agenda that outlines an action-oriented set of recommendations to address identified issues and problems.
  - d) Prepare and submit to the Governor a report that lays out a framework to carry out these recommendations.

5. (a) Five Committees shall be established to carry out the work of the Program. These Committees are the Air Issues Working Committee, Waste Issues Working Committee, Water Issues Working Committee Living and Ecological Resources Issues Working Committee and the Land Use Issues Working Committee. Each Committee will have two Co-Chairs who shall be appointed by the Governor. The Steering Committee Chairperson, referenced below, shall issue groundrules for the operation of the five Working Committees. Subject to the Steering Committee's approval, the Working Committees shall adopt workplans, which shall include mechanisms for public input.
- (b) Each working committee will be responsible for researching the broad scope of issues that fall within its preview; identifying the most critical emerging issues facing the state in terms of maintaining a quality environment for the future; conducting a detailed analysis of those issues; and recommending appropriate strategies with timetables for their resolution.
6. A Steering Committee for the Program shall be created to give oversight and guidance. Specifically, the Steering Committee shall develop a workplan for the program, coordinate the activities of the five Working Committees, and address cross-cutting

issues. The Steering Committee shall consist of the ten Working Committee Co-Chairs, the Secretary of Natural Resources and Environmental Control, the Secretary of Health and Social Services, the Secretary of Agriculture, the Secretary of Public Safety, Director of the Delaware Development Office, Director of the Solid Waste Authority, and a designee of the University of Delaware. A. Douglas Rothwell shall serve as Chairperson of this Steering Committee.

7. The Office of State Planning and Coordination shall provide staffing to the Steering Committee and assist the Chairperson as necessary. The Chairperson shall appoint a member of the Office of State Planning and Coordination to serve as Program Coordinator. This individual will coordinate the various activities of the Program and work of the Lead Staff Persons. The Program Coordinator shall serve under the direction of the Chairperson.
8. The Department of Natural Resources and Environmental Control (DNREC) will serve as the lead staff agency for the Program and appoint Lead Staff Persons for each of the Working Committees. DNREC will work under the direction the Chairperson and will have lead responsibility for providing technical information and expertise to the Program.
9. The five Working Committees shall submit final reports to the Steering Committee not later than June 30, 1987. The Steering Committee shall then submit a

final comprehensive report to the Governor by November 30, 1987. This report should set goals and priorities for natural resource protection or improvement and establish timetables for achieving results and methods for measuring progress. To the extent practicable, the report should consider the budgetary implications of its recommendations and communicate these to the Governor at the earliest possible time in accordance with the State's budget timetable.



APPROVED this 29<sup>th</sup> day  
of December, 1986.

Michael N. Gable  
Governor

ATTEST:

[Signature]  
Secretary of State

## ACKNOWLEDGEMENTS

### Steering Committee

A. Douglas Rothwell, Chair  
Maryland National Bank

R. Wayne Ashbee  
Director, Division of Water Resources

Martha Bogdan  
Executive Director  
Delaware Lung Association

William B. Chandler, Jr.  
Secretary, Department of Agriculture

William Conner (deceased)  
Delaware Law School

Thomas Eichler, Secretary  
Department of Health & Social Services

Lorraine Fleming  
Delaware Nature Education Society

Dr. Anthony Gaudy  
University of Delaware  
Dept. of Civil Engineering

Robert Halbrook, Esquire  
Wilson, Halbrook and Bayard

Dr. Robert R. Jordan  
Director, Delaware Geological Survey

Andrew Manus  
Executive Director  
Delaware Sea Grant College Program

Grace Pierce  
Delaware Audubon Society

I.F. Polasek  
Plant Manager  
Occidental Chemical Corporation

Phillip G. Retallick  
Director, Division of Air & Waste  
Management

Edward Steiner  
Secretary, Department of Public  
Safety

David Swayze, Esquire  
Duane, Morris and Heckscher

Jack Tarburton  
President, Delaware Farm Bureau

Robert J. Touhey, Asst. V. P.  
Environmental Affairs  
Standard Chlorine of Delaware

N.C. Vasuki  
General Manager  
Delaware Solid Waste Authority

Gerald Vaughn  
University of Delaware  
College of Agricultural Sciences

John E. Wilson, III  
Secretary  
Department of Natural Resources  
and Environmental Control

Dale Wolf  
Director  
Delaware Development Office



## Air Resources Committee

Martha Bogdan, Co-Chair  
Executive Director  
Delaware Lung Association

David Swayze, Esquire, Co-Chair  
Duane, Morris and Heckscher

Honorable David Ennis  
State Representative

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